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FINAL REPORT

Classification, Inventory and Analysis of SNF Wildlife Openings

Submitted by
Cooperative Wildlife Research Laboratory, SIU-C.

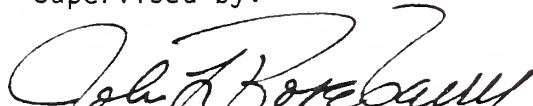
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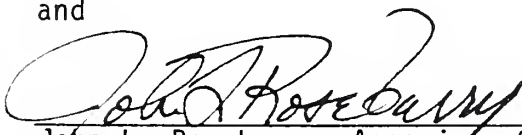
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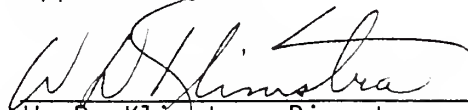
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FINAL REPORT

Shawnee Hills Project

W-94-R

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April 1, 1984 through December 31, 1985

STUDY I. CLASSIFICATION, INVENTORY, AND ANALYSIS OF SNF WILDLIFE OPENINGS

Job 1. Locate, Identify, and Describe Existing SNF Wildlife Openings

INTRODUCTION

The Shawnee National Forest (SNF), located in extreme southern Illinois, represents a discontinuous and diverse patchwork of timbered areas and oldfields interspersed with private lands which exhibit a variety of land-use types. The Forest is especially important to Illinois wildlife in that it represents the only extensive habitat that can be manipulated on a long-term basis. In 1950, the U. S. Forest Service and the Illinois Department of Conservation entered into a Memorandum of Understanding to cooperate in wildlife management; in 1956, Pittman-Robertson funds were designated for use to establish and maintain openings and water holes for wildlife.

Forest openings are known to influence the distribution and abundance of selected wildlife species (McGinnes and Ripley 1962,

Larson 1967, McCaffery and Creed 1969, Wunz 1979, McCaffery et al. 1981). Open areas are an important component of wild turkey (Meleagris gallopavo) habitat (Stoddard 1936, Lewis 1964, Holbrook and Lewis 1967, Bailey and Rinell 1967, Hillestad and Speake 1970, Speake et al. 1975) and more recent studies have identified clearings (pastures, oldfields, forest openings) as important brood rearing habitat (Hamrick and Davis 1972, Martin and McGinnes 1975, Hurst and Stringer 1975, Blackburn et al. 1975, Pack et al. 1980, Healy and Nenno 1983, Healy 1985). In addition, white-tailed deer (Odocoileus virginianus), ruffed grouse (Bonasa umbellus), and bobwhite (Colinus virginianus) as well as many non-game species also benefit from openings (Handy and Schannagel 1961, McCaffery and Creed 1969, Segelquist and Rogers 1974, McCaffery et al. 1981).

Approximately 1,550 maintained wildlife openings representing over 1,400 hectares presently exist within the Shawnee National Forest. Until recently, The Illinois Department of Conservation (IDOC) managed about 85 of these for upland game through the establishment of cereal grain food plots. Remaining openings are maintained by the Forest Service through periodic treatment. Present management consists of establishing tame legumes and grasses in openings containing undesirable vegetation. Burning, mowing, and herbicide applications are also utilized to manage vegetation.

Openings comprise only a small percentage of the total SNF area, but they may provide limiting factors for certain wildlife species. Therefore, information concerning characteristics of openings and

their surroundings is essential to effective management for the benefit of species requiring components of open habitats. In order to enhance the contribution of openings to overall management objectives of the SNF, a two phase project was initiated to collect information about openings and their management and to evaluate their importance to wildlife. Study I represents the first phase of that project. Objectives were to (1) describe, classify, and inventory a selected set of SNF wildlife openings, and (2) develop a computer storage and retrieval system to facilitate use of the information for management purposes.

STUDY AREA

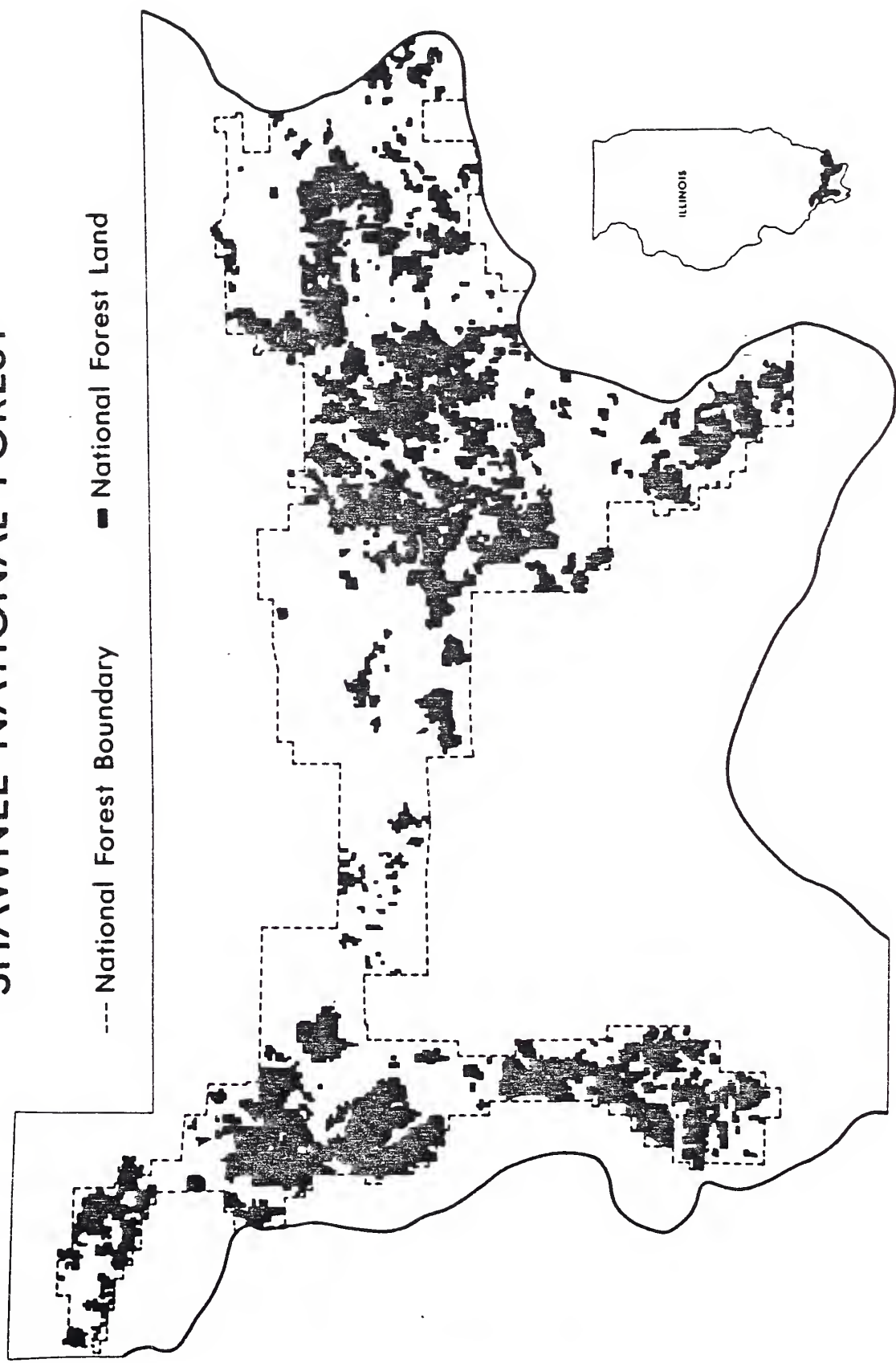
The Shawnee National Forest consists of 261,592 acres representing 31% of the area with the SNF purchase boundary. The Forest is a discontinuous patchwork of public forest interspersed with private lands (Fig. 1). Vegetative composition of private holdings within the purchase boundary includes grazed and ungrazed forest 38.0%, cropland 29.3%, pasture 25.2%, brush 1.2%, and other 5.3% (U. S. Forest Service 1985). The SNF is comprised of several major forest types including oak-hickory 64.9%, southern pine 17.5%, cove hardwoods 6.1%, bottomland hardwoods 4.4%, pin oak 1.0%, cedar 0.5%, walnut 0.2%, and oak-pine 0.2% (U. S. Forest Service 1983).

Natural Divisions

The SNF contains eight distinct natural environments and biotic communities which are defined by physiography, flora, and fauna (Schwegman 1973). These natural divisions include the Southern Till

Figure 1. Property ownership within the purchase boundary
of the Shawnee National Forest.

SHAWNEE NATIONAL FOREST

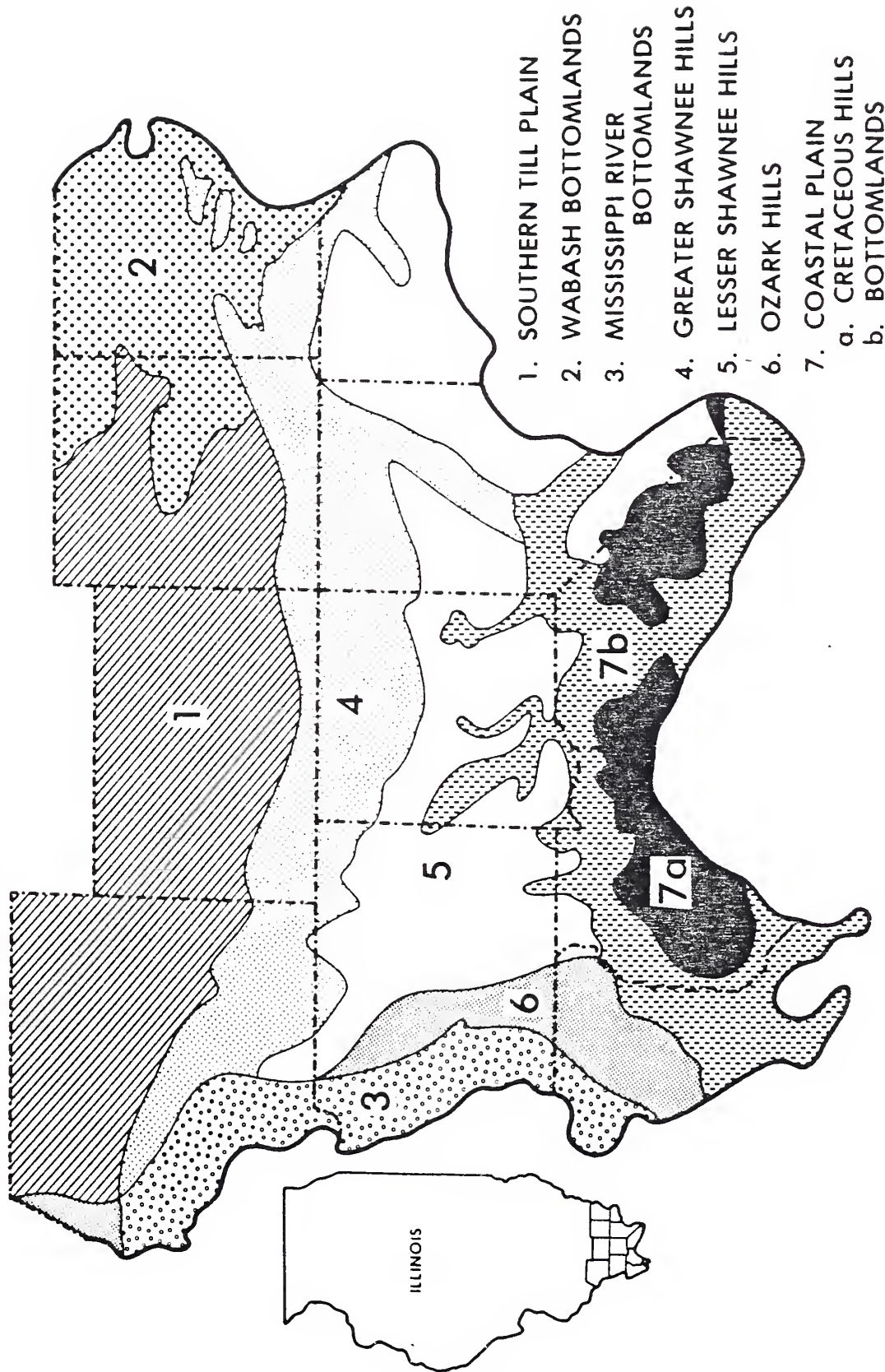


Plain, Wabash Border Bottomlands, Lower Mississippi River Bottomlands, Greater Shawnee Hills, Lesser Shawnee Hills, Ozark Hills, and upland and bottomland sections of the Coastal Plain Division (Fig. 2). Wildlife openings occur in all but the Wabash Border and Coastal Plain Bottomlands.

The Southern Till Plain (STP) is characterized by rolling, hilly topography. Soils have developed from thin loess and glacial till and have a high clay content; thus there is frequently a claypan subsoil. The Wabash Border Bottomlands (WBB) is river floodplain characterized by bottomland forests; floodplain and terrace soils predominate. The Lower Mississippi River Bottomlands (MRB) is a broad floodplain formed by glacial flood waters. Soils were developed from alluvium and are of fine texture, and areas of both sandy and clay soils exist. Bottomland forest species within this division include pin oak, overcup oak, Shumard oak, and cherry-bark oak. The unglaciated Shawnee Hills comprise the majority of the SNF. The Greater Shawnee Hills (GSH) are formed by a high east-west escarpment of sandstone cliffs; the Lesser Shawnee Hills (LSH) are identified by a series of lower hills underlain by limestone and sandstone. Soils of these divisions are derived primarily from a thin loess layer, which is thickest along the Mississippi River and becomes thinner eastward; claypan and fragipan layers are common. Upland forests are characterized by mixed oak and hickory species. The southern section of the Ozark Hills Division (OHS) is characterized by steep ravines and narrow ridge tops; steep bluffs along the Mississippi River and distinctive southern and Ozarkian flora are

Figure 2. Natural divisions within the Shawnee National
Forest.

NATURAL DIVISIONS OF SOUTHERN ILLINOIS



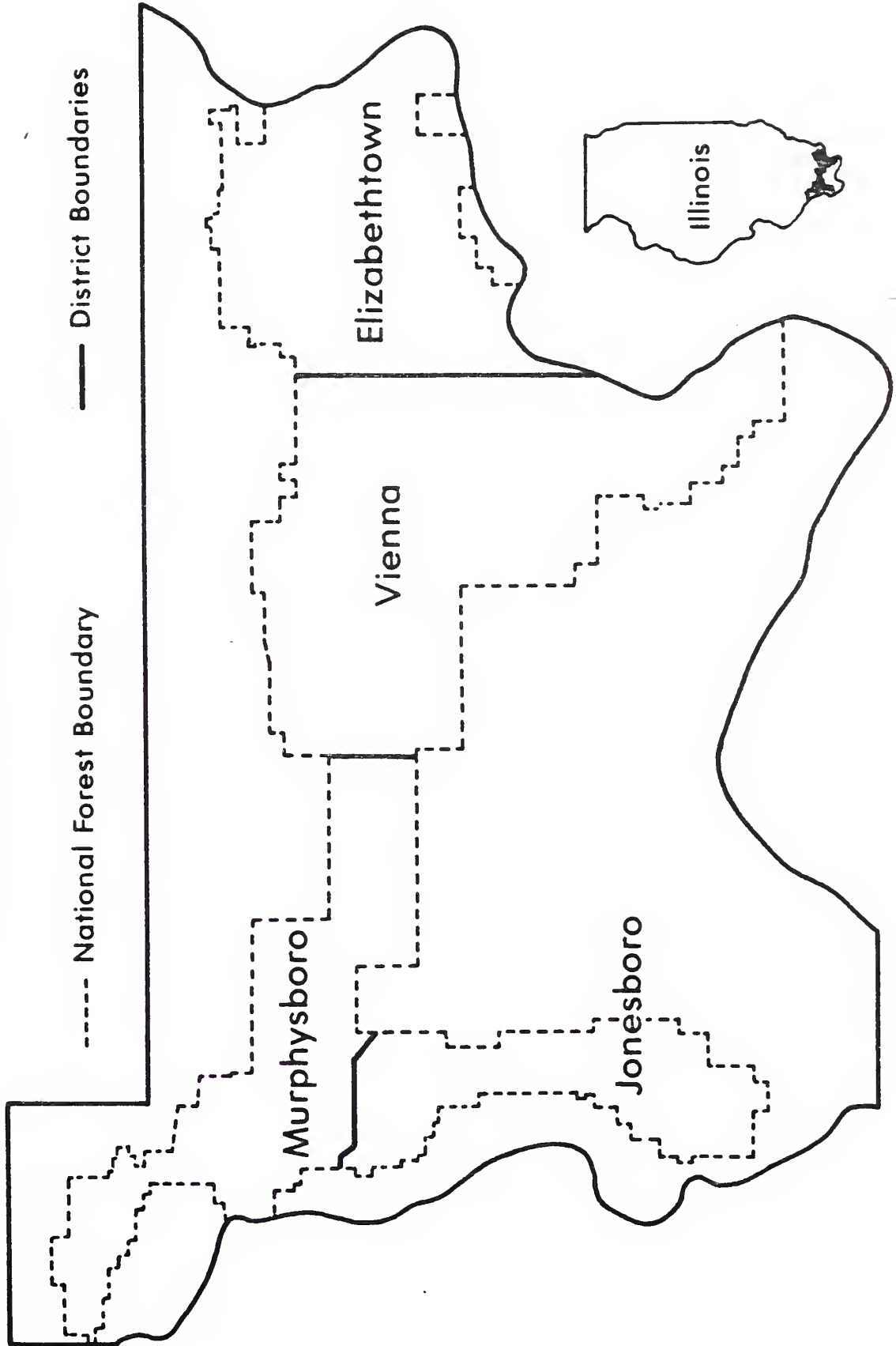
also indicative of this division. Soils are derived from deep loess, but thin soils occur over bedrock outcrops and in ravines. Encompassing the southeastern portion of the SNF is the Coastal Plain Division, which consists of a Bottomland (CPB) and a Cretaceous Hills (CPC) section. Topography of the Coastal Plain Cretaceous Hills includes steep to rolling hills comprised of unconsolidated Cretaceous and Tertiary sands, gravels, and clays. There are prairie remnants or "Barrens" on some upland sites. Little bluestem dominates these areas with big bluestem and Indian grass represented on more mesic sites. The bottomlands section encompasses the floodplains of the Cache, Ohio, and Mississippi rivers. Soils range from recent alluvium to older terrace soils. Undisturbed areas of this section are characterized by swampy bottomland forests.

Districts

For administrative purposes, the SNF is divided into 4 ranger districts: Murphysboro, Jonesboro, Vienna, and Elizabethtown (Fig. 3). The Murphysboro district is diverse physiographically, encompassing the Southern Till Plain, Greater and Lesser Shawnee Hills, Mississippi River Bottomlands, and Ozark Hills natural divisions. Portions of the Greater and Lesser Shawnee Hills, Cretaceous Hills, and Coastal Plain Bottomlands comprise the Vienna district. The Elizabethtown district contains portions of the Greater and Lesser Shawnee Hills and Wabash Bottomlands; the Jonesboro district is represented only by the Ozark Hills.

Figure 3. Ranger districts of the Shawnee National
Forest.

SHAWNEE NATIONAL FOREST



Climate

The climate of southern Illinois is characterized by long, hot, humid summers and short, mild winters. The average annual temperature in Carbondale is about 14° C; summers (July) average 26° C and winters (January) 3° C (Voigt and Mohlenbrock 1964). The average growing season ranges from 185 to 200 days. Annual precipitation averages 112 cm; snowfall is occasional and snow cover usually of short duration.

METHODS

Inventory

Some inventory data were obtained remotely whereas some required field visitations. For this reason, sample sizes of inventoried openings vary by recorded variable. Those variables considered most pertinent or most easily obtained were emphasized. Locations were recorded for 1,572 openings initially known to exist within the SNF; surrounding land-use data were obtained for 1,137 of these. Over 600 openings were visited by researchers during the course of the project and over 200 were sampled to obtain quantitative vegetation data. This latter group included primarily IDOC-managed openings, openings selected for analysis in Study II, and openings selected to evenly represent the various natural divisions.

Location data for each opening (district, compartment, county, range, township, section, quarter, and opening number) were obtained from U. S. Forest Service topographic maps. ASCS aerial photographs, taken especially for the SNF in winter 1980-81 at a scale of 1:12,000, were used to determine surrounding land use, kilometers of roads, number of managed openings, and number of dwellings within 0.5- and

1.0-km radii around selected openings. Land uses identified included cropland, pasture/hayfield, coniferous and deciduous forest, and other openings. Measurements were obtained using a dot grid (1 dot = 0.145 ha) with 0.5- and 1.0-km radii circles which were centered over selected openings. Size of openings was determined from a separate dot grid (1 dot = 0.052 ha). Also measured (with a map measurer) were distance to nearest managed opening, dwelling, gravel road, cropland, pasture/hayfield, and water.

Classification

Classification of openings utilized an existing system, Wildlife Management Information System (WMIS), which is the storage and retrieval system used by the eastern region of the U. S. Forest Service, but is not fully operational within the SNF. For a more complete description of WMIS and its terminology, see the Interim Guide for Wildlife Management Information System for the Shawnee National Forest (U. S. Forest Service 1983). WMIS classification was modified to include additional vegetative types that better represent opening vegetation in the SNF. A resemblance matrix formed from Bray-Curtis percent similarity (Gauch 1977) was used in conjunction with Group Averaging cluster analysis (Sneath and Sokal 1973) to determine floristically similar groups of openings. Species percent cover values were used to form the initial data matrix.

Openings were also classified by surrounding dominant forest type utilizing aerial photographs and timber stand data; field inspections verified this methodology. This procedure permitted identification

of openings influenced by large pine stands, primarily on ridge tops, while allowing other openings in or near minor pine stands to be classified by the most dominant forest type in that area.

Composition and structure of vegetation in selected openings was sampled along 4 transects radiating in each of the cardinal compass directions from the approximate center of the opening. Every 4 steps a 30 X 30-cm quadrat was placed at the toe of the investigator. Within each quadrat, ocular estimation of percent cover of herbaceous and shrubby vegetation by species, percent basal area, and percent bare ground were made. A maximum of 10 quadrats per transect was sampled; height of the forb and grass layer was recorded every 4th quadrat. Vegetation sampling was conducted July-October 1984 and June-September 1985. Opening location relative to slope was also recorded (e.g. ridge top or floodplain) as was prevailing slope (measured with an Abney level) and aspect.

RESULTS

Location

The location of 1,572 recent or currently maintained openings in the SNF was recorded by township, range, section, quarter section, compartment, and individual number (Appendix A). Some of these, however, have since been dropped from further management consideration. As of 1 January 1986, 1,528 maintained openings existed according to the U. S. Forest Service.

Natural Division and Ranger District

Over 70% of all managed openings in the SNF were in the Greater and Lesser Shawnee Hills. Frequency of occurrence by division was

Greater Shawnee Hills (GSH) 847, Lesser Shawnee Hills (LSH) 312, Ozark Hills (OHS) 248, Coastal Plain Cretaceous Hills (CPC) 82, Southern Till Plain (STP) 61, and Mississippi River Bottomlands (MRB) 22 (Table 1). The number of openings by ranger district was Vienna 538, Murphysboro 410, Elizabethtown 406, and Jonesboro 218.

Surrounding Forest Type

The majority of openings in all divisions (one exception) and districts were dominated by oak-hickory stands (Appendix B1, C1). Openings influenced by southern pine stands were of lesser importance. Surrounding forest type was related to natural division. For example, over 75% of the openings in the OHS were dominated by oak-hickory and only 4% by southern pine; a reflection of the narrow ridge tops and steep ravine terrain of that division. In contrast, topography of the GSH, LSH, and CPC allowed for more pine plantations resulting in 26-35% pine-dominated openings. Approximately 23% of the STP openings were dominated by cove hardwoods, primarily reflecting plantations of sweet gum and tulip which were often planted on upland sites in association with openings. Managed openings in the MRB were dominated mainly by bottomland hardwoods and pin oak stands associated with the Big Muddy River floodplain.

Forest community types associated with openings varied by ranger district. Oak-hickory and southern pine predominated in the Vienna district (Appendix C1) with openings dominated by immature (20-39 year old) southern pine slightly more numerous than those associated

Table 1. Percent frequency of openings by district for natural divisions of the Shawnee National Forest.

Natural division	N	District				Total
		Elizabethtown N=406	Jonesboro N=218	Murphysboro N=410	Vienna N=538	
Cretaceous Hills	82	0.0	0.0	0.0	15.2	5.2
Greater Shawnee Hills	847	50.7	0.0	68.5	66.9	53.9
Lesser Shawnee Hills	312	49.3	0.0	3.9	16.2	19.8
Mississippi River Bottomlands	22	0.0	0.0	5.4	0.0	1.4
Ozark Hills	248	0.0	100.0	7.3	0.0	15.8
Southern Till Plain	61	0.0	0.0	14.9	0.0	3.9
TOTAL	1572	25.8	13.9	26.1	34.2	100.0

with mature (80-99 years old) oak-hickory. The Murphysboro district, which contains 5 natural divisions, exhibited the widest variety of forest community types, with oak-hickory predominating. In the Jonesboro district, over 80% of the openings were dominated by mature oak-hickory stands. Lack of variety in that particular district reflected physiography, suitable hardwood soils, and Forest Service ownership patterns. Openings in the Elizabethtown district were similar to Vienna with respect to surrounding forest types except for more white pine dominated openings. A small percentage of the openings in the Elizabethtown, Murphysboro, and Vienna districts were located in or dominated by oldfield or brush habitats.

Characteristic Vegetation

Cluster analysis performed on species cover values from 204 openings revealed approximately 24 groups and/or distinct opening types (Table 2, Appendix D) which were used to classify opening vegetation. These vegetative categories include original WMIS types as well as previously undescribed types. The 15 most dominant species by mean cover value and percent frequency are shown in Table 3. A list of all species identified (Appendix E) as well as those species most frequently encountered were also compiled (Table 4). Upon delineation of vegetation types, an additional 255 openings were classified (Appendix B2, C2).

Several vegetation types were representative of stages of secondary succession as identified by Bazzas (1968). This would be expected due to the disturbance caused by elimination of fescue and the establishment

Table 2. Opening vegetation types identified by cluster analysis.

Vegetation types
1. Little bluestem
2. Indian grass, big bluestem, little bluestem
3. Orchard grass, forb
4. Ragweed, wild carrot, lespedeza
5. Broom sedge, panic grass, aster
6. Purple top, bluegrass, panic grass, coralberry
7. Goldenrod
8. Sassafras, persimmon, sumac
9. Fescue
10. Cool season grasses
11. Cereal grain
12. Tame legumes
13. Legume, goldenrod, wild carrot, annual brome grasses, sweetclover
14. Fescue, goldenrod
15. Deer's tongue, sedge, jewelweed
16. Forb, - little bluestem
17. Panicum, western ragweed, beggar-ticks, fleabane, goldenrod, redtop
18. Beggar-ticks
19. Honeysuckle
20. Vetch
21. Sericea lespedeza
22. Smooth brome
23. Aster, sedge, beggar-ticks, moneywort, sawtooth sunflower
24. Sweet clover

Table 3. Dominant plants by percent cover and frequency for 204 openings of the Shawnee National Forest.

Species	Cover			Frequency
	Mean	Standard deviation	Maximum	
<u>Solidago</u> spp.	16.6	14.1	67.1	93.1
<u>Festuca</u> spp.	9.9	17.2	94.0	53.9
<u>Rubus</u> spp.	6.4	9.0	41.0	77.0
<u>Panicum</u> spp.	5.7	10.2	57.0	65.7
Sassafras	4.9	9.8	52.0	45.1
Red clover	3.3	12.9	99.1	31.4
<u>Bromus</u> spp.	2.9	5.6	31.0	57.4
Honeysuckle	2.6	8.5	65.7	28.9
Red top	2.4	4.9	25.0	41.7
Common cinquefoil	2.3	4.2	26.9	43.6
Common ragweed	2.2	7.0	60.0	41.7
Woodland sunflower	2.2	5.6	37.5	24.5
Little bluestem	2.0	7.4	53.3	20.1
<u>Aster</u> spp.	1.9	5.1	48.0	54.4
<u>Desmodium</u> spp.	1.8	3.3	19.8	55.9

Table 4. Dominant plants by percent frequency and cover for 204 openings of the Shawnee National Forest.

Species	Frequency	Cover		
		Mean	Standard Deviation	Maximum
<u>Solidago</u> spp.	93.1	16.6	14.1	67.1
<u>Rubus</u> spp.	77.0	6.4	9.0	41.0
<u>Panicum</u> spp.	65.7	5.7	10.2	57.0
<u>Bromus</u> spp.	57.4	2.9	5.6	31.0
<u>Desmodium</u> spp.	55.9	1.8	3.3	19.8
<u>Aster</u> spp.	54.4	1.9	5.1	48.0
<u>Festuca</u> spp.	53.9	9.9	17.2	94.0
Sassasfras	45.1	4.9	9.8	52.0
Common cinquefoil	43.6	2.3	4.2	26.9
Common ragweed	41.7	2.2	7.0	60.0
Red top	41.7	2.4	4.9	25.0
Poison Ivy	40.7	1.7	3.7	30.0
Yarrow	37.3	0.5	1.1	8.0
<u>Erigeron</u> spp.	35.8	1.1	3.4	33.0
Wild carrot	35.3	1.1	3.6	30.6

of legumes. The ragweed-wild carrot-lespedeza, and beggar-ticks types (see Appendix E for scientific names) were associated with the most recently disturbed openings. Nine of 26 openings visited within the CPC were dominated by ragweed as a result of attempted legume establishment (Appendix B2). After mowing, the planted legume component usually persisted for several years depending on seeding rate, mixture, and frequency of follow-up mowing. Some vegetative types were more permanent. Goldenrod, little bluestem, broom sedge, and fescue were perennial types that would likely persist given periodic mowing and/or burning. Approximately 30% of the openings visited in the Vienna and Elizabethtown districts contained a large fescue component (Appendix C2). Openings which had been neglected for 4 to 6 years exhibited heavy woody influence to the point, in some cases, of domination. The sassafras-persimmon-sumac type identified those openings which were often past the desirable herbaceous stage for some wildlife species. Approximately 25% of the openings visited in the Jonesboro district were of this type whereas none were found in the Vienna district.

A number of openings were dominated by or at least contained remnants of native warm season grasses. Little bluestem was indicative of sites not yet disturbed or at least not recently disturbed. This type occurred most frequently in the Shawnee Hills and Cretaceous Hills of the Vienna and Elizabethtown districts (Appendix B2 and C2). Over 30% of the openings visited in those areas contained at least some little bluestem. The Indian grass-big bluestem type was also found more frequently than expected. The STP division contained

several openings that possessed significant amounts of Indian grass, and many others not recently disturbed contained remnant stands; big bluestem was also encountered but was not as prevalent as Indian grass.

Size

Mean size of 1,376 measured openings was 0.52 ha. Size varied by natural division, ranging from 0.61 ha in CPC to 0.35 ha in OHS and STP (Table 5). Most openings (65%) in the OHS and STP divisions were from 0.2 to 0.4 ha whereas most (>50%) in the LSH, GHS, and CPC were from 0.3 to 0.6 ha (Appendix B3). The latter divisions as well as the STP contain generally flat upland sites and broader ridge tops compared to the steep ravine and narrow ridge top topography of the OHS.

Size of openings also varied by district, ranging from a mean of 0.33 in Jonesboro to 0.62 ha in Elizabethtown (Table 6). Most openings within the Jonesboro and Murphysboro districts were from 0.2 to 0.4 ha in size while most in Elizabethtown and Vienna were from 0.3 to 0.6 ha (Appendix C3).

Soils

Openings within the SNF are found on a variety of soil types. Distinct soil groups were associated with openings from different parts of the Forest, but Hosmer and Alford soils (characteristic of uplands) were most common in 5 of the 6 natural divisions (Appendix B4). Approximately 70% of the CPC openings were on Hosmer soils compared to 26 and 21%, respectively, for LSH and GSH openings.

Table 5. Size (ha) of openings by natural division, Shawnee National Forest.

Natural division	N	Mean	Standard deviation	Minimum	Maximum
Cretaceous Hills	83	0.61	0.30	0.1	1.7
Greater Shawnee Hills	779	0.55	0.42	0.1	4.9
Lesser Shawnee Hills	265	0.57	0.40	0.1	3.9
Mississippi River Bottomlands	17	0.39	0.56	0.1	2.4
Ozark Hills	177	0.35	0.26	0.1	1.4
Southern Till Plain	57	0.35	0.17	0.1	0.9
TOTAL	1378	0.52	0.40	0.1	4.9

Table 6. Size (ha) of openings by ranger district, Shawnee National Forest.

District	N	Mean	Standard deviation	Minimum	Maximum
Elizabethtown	361	0.62	0.44	0.1	3.9
Jonesboro	147	0.33	0.27	0.1	1.4
Murphysboro	347	0.39	0.28	0.1	2.4
Vienna	523	0.59	0.41	0.1	4.9
TOTAL	1378	0.52	0.4	0.1	4.9

Forty percent of the openings within the latter 2 divisions were on Grantsburg soils, which are also characteristic of ridge tops and hillsides. Openings located in narrow stream valleys within upland areas of the GSH and LSH usually exhibited Burnside soils. Over 60% of the STP openings were on Alford soils and 34% were on Hosmer soils. Similarly, 50% of OHS openings showed Alford and Goss-Alford complex soils and over 30% were associated with Elsay and Haymond soils which are found in narrow bottomlands and adjacent to stream channels. Jacob series soils, which are floodplain soils adjacent to major streams, were associated with over 50% of the openings within MRB.

On a district basis, Murphysboro openings exhibited the greatest diversity of soil types (Appendix C4). This would be expected owing to the representation of 5 natural divisions within district boundaries.

Access

Access to most openings consisted of dirt or grass covered roads that were passable when dry but traversable only by 4-wheel drive vehicles or tractors when wet. Road conditions ranged from excellent to heavily rutted. Condition often depended upon proximity to Forest Service fishponds, hunting pressure, and local All Terrain Vehicle enthusiasm. Access to openings was categorized as gravel road, dirt/grass road, dirt/grass road-tractor needed, dirt/grass-3-wheeler needed, or no vehicle access (Appendix B5). Over 50% of all openings examined had a dirt/grass access road negotiable by a 2-wheel drive truck in dry conditions. Exceptions occurred in the MRB and OHS.

In the former area, soils were often too wet for vehicle access, a situation aggravated by natural drainage conditions. In the OHS, access trails were often too narrow or heavily rutted by 3-wheeler activity to be passable.

Access also varied by district (Appendix C5), primarily due to the representation of different physiographic divisions and the frequency of opening manipulation. Many roads in the Elizabethtown and Vienna districts have been upgraded to accommodate pine thinning and harvesting.

Aspect and Slope

Orientation in relation to aspect was recorded for 394 openings that had detectable corresponding slopes. There were no obvious trends by natural division (Appendix B6) or district (Appendix C6). Opening location is apparently determined more by chance site availability than by predetermined placement and orientation.

Percent slope was recorded for 480 openings; most ranged from 0 to 7%. There was noticeable variation by natural division (Appendix B7) but not district (Appendix C7). Influence of the MRB floodplain and the flat ridge tops of the OHS division was apparent.

Surrounding Land Use

Deciduous forest.--Land use within a 0.5-km radius (78 ha) of 1,137 openings was recorded and measured. As would be expected, deciduous forest predominated, occupying 71% of the total area surveyed around all openings. Representation of this land-use type within natural divisions varied from approximately 90% in the MRB and OHS

to 65-67% in the LSH and GSH (Table 7, Fig. 4). By district, Jonesboro openings contained the most surrounding deciduous forest (90%) and Vienna the least (66%) (Table 8, Fig. 5). Predominance of this land-use type in the OHS division and Jonesboro district reflected the steep ravines, dissected topography, and generally favorable hardwood growing conditions characteristic of these areas. Presence of Oakwood Bottoms Greentree Reservoir accounted for the large forested acreage surrounding the small number of openings sampled in the MRB. Although some openings were not associated with any deciduous forest, 2/3 of those sampled contained at least 60% of this land-use type within a 0.5-km radius (Appendix B8, C8).

Coniferous forest.--Overall, coniferous forest occupied 18% of the area surrounding sampled openings. Representation ranged from about 21% in the GSH, LSH, and CPC divisions to 0-2% for MRB and OHS (Table 9, Fig. 4). Broader ridge tops and a generally flatter upland topography often found in the former 3 divisions provided suitable areas for pine production. Over 1/3 of the openings in them contained from 16 to 30% coniferous forest with maximum amounts of 86, 78, and 59%, respectively (Appendix B9). This contrasts with the MRB and OHS which had none or very few openings in or near pine stands. By district, Vienna and Elizabethtown showed 24% and 19% pine around openings, respectively, compared to 10% and 2% for Murphysboro and Jonesboro (Table 10, Appendix C9). This contrast again reflected the natural divisions and conditions for pine planting associated with various districts.

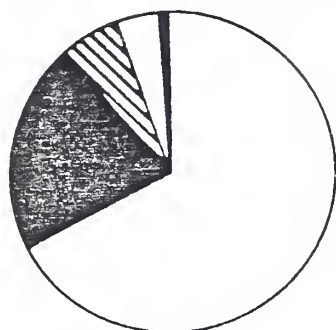
Table 7. Percent deciduous habitat within a 0.5-km radius of openings by natural division, Shawnee National Forest.

Natural division	N	Mean	Standard deviation	Minimum	Maximum
Cretaceous Hills	82	70.0	19.0	12.0	99.0
Greater Shawnee Hills	662	67.8	17.8	4.0	99.0
Lesser Shawnee Hills	186	65.4	17.8	5.0	97.0
Mississippi River Bottomlands	17	90.7	10.6	65.0	99.0
Ozark Hills	152	88.8	10.0	60.0	100.0
Southern Till Plain	38	74.1	13.8	41.0	91.0
TOTAL	1137	70.9	18.5	4.0	100.0

Table 8. Percent deciduous habitat within a 0.5-km radius of openings by district, Shawnee National Forest.

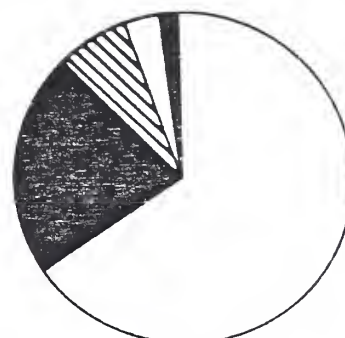
District	N	Mean	Standard deviation	Minimum	Maximum
Elizabethtown	286	68.7	16.8	5.0	99.0
Jonesboro	125	89.7	9.0	60.0	100.0
Murphysboro	200	76.3	18.6	8.0	99.0
Vienna	526	65.5	17.5	4.0	99.0
TOTAL	1137	70.9	18.5	4.0	100.0

GREATER SHAWNEE HILLS



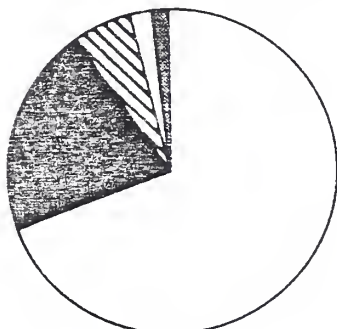
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LESSER SHAWNEE HILLS



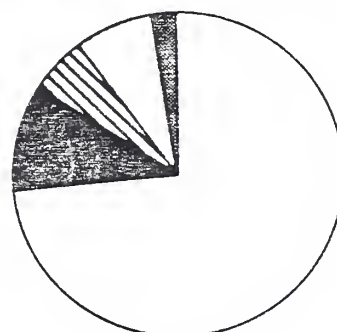
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CRETACEOUS HILLS

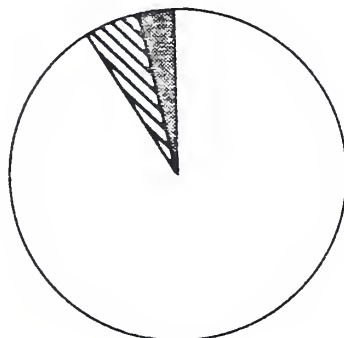


N=82

SOUTHERN TILL PLAIN

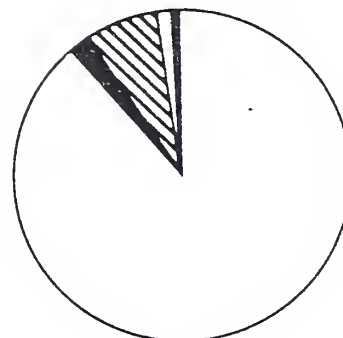


N=38

MISSISSIPPI RIVER
BOTTOMLANDS

N=17

OZARK HILLS



N=152

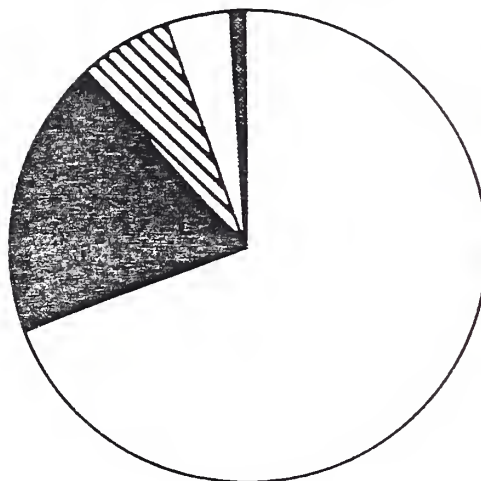
LEGEND



Figure 4. Proportion of habitat types surrounding openings
for natural divisions of the Shawnee National Forest.

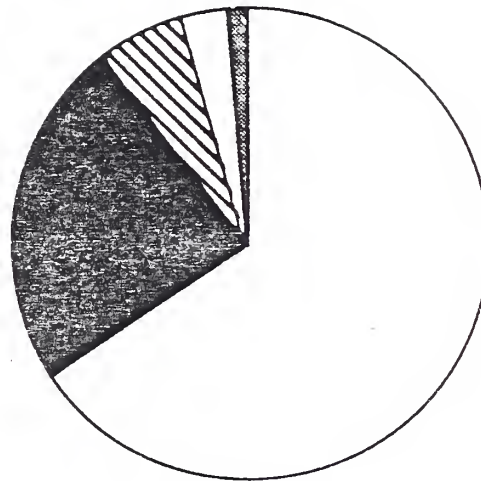
Figure 5. Proportion of habitat types surrounding openings
for districts of the Shawnee National Forest.

ELIZABETHTOWN



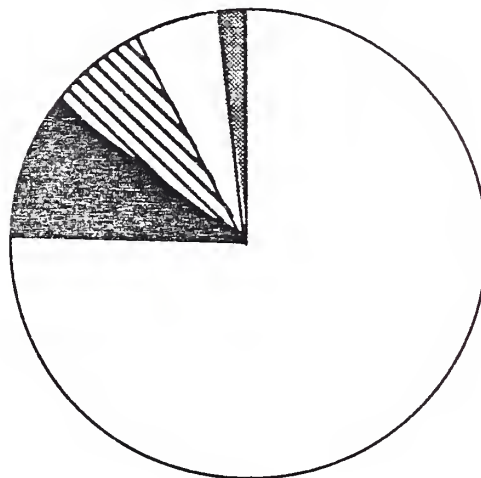
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VIENNA



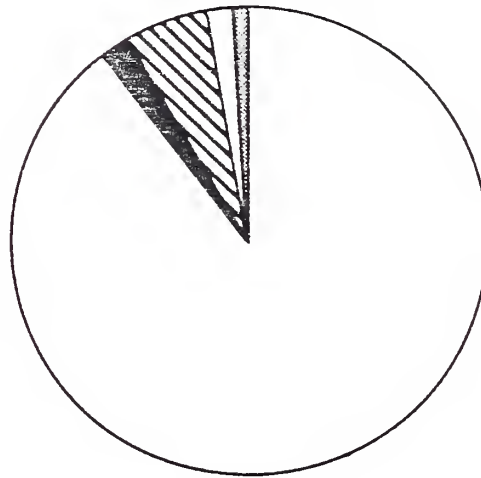
N=526

MURPHYSBORO



N=200

JONESBORO



N=125

LEGEND



Table 9. Percent coniferous habitat within a 0.5-km radius of openings by natural division, Shawnee National Forest.

Natural division	N	Mean	Standard deviation	Minimum	Maximum
Cretaceous Hills	82	20.9	14.3	0.0	59.0
Greater Shawnee Hills	662	21.1	15.3	0.0	86.0
Lesser Shawnee Hills	186	21.3	17.1	0.0	78.0
Mississippi River Bottomlands	17	0.0	0.0	0.0	0.0
Ozark Hills	152	2.1	3.7	0.0	15.0
Southern Till Plain	38	10.9	9.2	0.0	37.0
TOTAL	1137	17.9	15.9	0.0	86.0

Table 10. Percent coniferous habitat within a 0.5-km radius of openings by district, Shawnee National Forest.

District	N	Mean	Standard deviation	Minimum	Maximum
Elizabethtown	286	19.4	14.6	0.0	78.0
Jonesboro	125	2.0	3.9	0.0	15.0
Murphysboro	200	9.4	12.1	0.0	86.0
Vienna	526	24.1	15.6	0.0	86.0
TOTAL	1137	17.9	15.9	0.0	86.0

Open habitat.--The amount of open habitat (oldfields, clearcuts, other openings, etc.) surrounding sampled openings was relatively constant (5.5-7.2%) across all divisions (Table 11); however, some openings in the LSH and GSH divisions were surrounded by as much as 42% open habitat. Furthermore, the type of open cover represented in the various divisions was quite different. Large amounts of such habitat surrounding openings in the OHS and MRB (excluding that contributed by other maintained openings) was almost exclusively associated with clearcut areas less than 5 years old. In contrast, open habitat near managed openings in the GSH, LSH, CPC, and STP divisions often represented young pine or tulip plantations established in former oldfields; scattered small unplanted oldfields also contributed. Total amounts of open habitat varied little among districts (Table 12), although type of habitats differed considerably depending on representation of natural divisions. Regardless of division or district, nearly 1/3 of all openings sampled contained 3% or less nearby open habitat, and over 3/4 showed less than 10% (Appendix B10, C10).

Cropland.--The total amount of surrounding cropland varied from less than 1% in the GSH and OHS to 3.6% in the MRB division and totaled just over 1% for all sampled openings (Table 13). Approximately 1/4 of the openings in the STP and MRB divisions contained at least 3% cropland (Appendix B11). The generally flat upland areas of the glaciated STP and the floodplains of the MRB accounted for this modest representation. Average amounts of surrounding cropland varied by district only from 0.9 to 1.7% (Table 14), the result of pooling

Table 11. Percent open habitat within a 0.5-km radius of openings by natural division, Shawnee National Forest.

Natural division	N	Mean	Standard deviation	Minimum	Maximum
Cretaceous Hills	82	5.5	4.7	0.0	25.0
Greater Shawnee Hills	662	5.9	5.1	0.0	42.0
Lesser Shawnee Hills	186	7.2	7.1	0.0	42.0
Mississippi River Bottomlands	17	5.5	5.7	0.0	17.0
Ozark Hills	152	6.7	7.6	0.0	31.0
Southern Till Plain	38	5.6	3.3	1.0	14.0
TOTAL	1137	6.1	5.8	0.0	42.0

Table 12. Percent open habitat within a 0.5-km radius of openings by district, Shawnee National Forest.

District	N	Mean	Standard deviation	Minimum	Maximum
Elizabethtown	286	6.2	6.9	0.0	42.0
Jonesboro	125	5.5	6.3	0.0	28.0
Murphysboro	200	6.8	5.8	0.0	31.0
Vienna	526	6.0	4.9	0.0	33.0
TOTAL	1137	6.1	5.8	0.0	42.0

Table 13. Percent cropland within a 0.5-km radius of openings by natural division, Shawnee National Forest.

Natural division	N	Mean	Standard deviation	Minimum	Maximum
Cretaceous Hills	82	1.4	4.3	0.0	25.0
Greater Shawnee Hills	662	0.8	3.2	0.0	26.0
Lesser Shawnee Hills	186	2.4	6.3	0.0	41.0
Mississippi River Bottomlands	17	3.6	7.9	0.0	28.0
Ozark Hills	152	0.7	2.8	0.0	20.0
Southern Till Plain	38	2.3	4.7	0.0	21.0
TOTAL	1137	1.2	4.1	0.0	41.0

Table 14. Percent cropland within a 0.5-km radius of openings by district, Shawnee National Forest.

District	N	Mean	Standard deviation	Minimum	Maximum
Elizabethtown	286	1.0	4.1	0.0	41.0
Jonesboro	125	0.9	3.1	0.0	20.0
Murphysboro	200	1.7	4.8	0.0	28.0
Vienna	526	1.2	4.0	0.0	34.0
TOTAL	1137	1.2	4.1	0.0	41.0

data from different divisions within each district. Overall, only 6 of 1130 openings sampled had more than 25% cropland within a 0.5-km radius (Appendix C11).

Pasture/hayfield.--These land-use types comprised 3.6% of the total area surrounding sampled openings. Amounts varied from 0 within the MRB to 7.6% for the STP (Table 15). This difference reflects the former regions suitability for rowcrops (fertility, flatness) contrasted with the STP's rolling uplands which are more suitable for forage crops. Representation of these land-use types by district varied from 5.3% in Murphysboro to 1.8% in Jonesboro (Table 16).

Nearly 3/4 of the openings samples in all divisions and districts (Appendix B12, C12) had 3% or less nearby pasture/hayfield acreage.

Distance to Land-Use Types

Cropland.--Approximately 25% of all openings sampled in the CPC, LSH, STP, and MRB divisions were within 400 m of a rowcrop. Overall, however, 50% of the openings in each district and division (with one exception) were farther than 800 m (Appendix B13, C13). The exception was the glaciated STP division which contains many small but generally level fields adjacent to Forest Service property.

Pasture/hayfield.--From 18 to 25% of the openings examined in the STP, GSH, and LSH divisions were within 200 m of a pasture or hayfield, and from 70 to 90% were within 800 m (Appendix B14). In contrast, only about 6% of the openings within CPC and OHS were within 200 m of these land-use types and 42-50% were farther than 800 m. Forage crops were virtually absent from sampled areas within MRB.

Table 15. Percent pasture/hayfield habitat within a 0.5-km radius of openings by natural division, Shawnee National Forest.

Natural division	N	Mean	Standard deviation	Minimum	Maximum
Cretaceous Hills	82	2.5	6.2	0.0	36.0
Greater Shawnee Hills	662	4.1	8.3	0.0	54.0
Lesser Shawnee Hills	186	3.4	6.9	0.0	34.0
Mississippi River Bottomlands	17	0.0	0.0	0.0	0.0
Ozark Hills	152	1.5	4.0	0.0	23.0
Southern Till Plain	38	7.6	8.9	0.0	30.0
TOTAL	1137	3.6	7.5	0.0	54.0

Table 16. Percent pasture/hayfield habitat within a 0.5-km radius of openings by district, Shawnee National Forest.

District	N	Mean	Standard deviation	Minimum	Maximum
Elizabethtown	286	4.2	8.2	0.0	45.0
Jonesboro	125	1.8	4.4	0.0	23.0
Murphysboro	200	5.3	10.1	0.0	54.0
Vienna	526	3.0	4.0	0.0	34.0
TOTAL	1137	3.6	7.5	0.0	54.0

Differences by district (Appendix C14) reflected the representation of natural divisions and their variation described above.

Open habitat.--Approximately 50% of the sampled openings were within 100 m of some other open habitat (Appendix B15, C15) including cropland, pasture/hayfield, oldfield, right-of-way, barrens and glade habitat, recent clearcuts, and/or other maintained openings. Almost all sampled openings were within 400 m of such areas.

Water.--About 75% of all openings examined were within 200 m of a water source and very few were farther than 400 m (Appendix B16, C16). Approximately 44% of the nearest water sources were Forest Service waterholes or fishponds, 43% were intermittent or small streams, 9% were large streams or rivers, 3% were lakes, and 1% miscellaneous. The influence of Forest Service waterholes and fishponds was most evident in the Jonesboro district where approximately 63% of the openings had waterholes or fishponds as their closest water source with over half within 50 m.

Dwellings.--About 54% of all openings sampled were over 900 m from the nearest human dwelling, although only 35% of the STP division openings were in this category (Appendix B17). In the Jonesboro and Vienna districts, over 60% of the openings were more than 900 m from a dwelling compared to only 43% in Murphysboro (Appendix C17). This would be expected as the latter district is mainly comprised of the relatively populated Jackson County whereas much of the Vienna and Jonesboro districts are mainly contained in two of the most rugged natural divisions in southern Illinois (GSH and OHS). Over 80% of

the openings examined throughout the SNF contained no dwellings within a 0.5-km radius (Appendix B18, C18).

Gravel roads.--Average distance to public gravel or open Forest Service roads did not vary substantially by division (Appendix B19) with the exception of MRB where levee and access roads associated with the Oakwood Bottoms Greentree Reservoir were in generally closer proximity to openings. Over 33% of the openings measured in the Jonesboro district were within 100 m of a gravel road compared to 10-12% for Murphysboro and Vienna (Appendix C19). Many of these roads in the former district were established for timber harvest and management purposes.

From 68 to 79% of the openings within the CPC, LSH, GSH, and OHS divisions contained no gravel and/or paved roads within a 0.5-km radius (Appendix B20). Sixty-one percent of the Murphysboro district openings fell into this category compared to 76% for the more remote openings in the Jonesboro and Vienna districts (Appendix C20).

Density of and Distance to Managed Openings

The number of managed openings within 0.5-km and 1.0-km were counted for 1,384 and 1,374 openings respectively. The lowest density of openings occurred within the MRB division where approximately 80% of the small number sampled has less than 1 other managed opening within a 0.5 km radius (Appendix B21) and 100% has 4 or less nearby openings within a 1.0 km radius (Appendix B22). Comparable figures for the OHS division were 45% and 56%. In contrast, 50% of the openings in all other divisions had at least 2-4 other openings within a 0.5-km

radius and 5-10 within a 1.0-km radius. Density of openings was similar among districts except for Jonesboro where nearly 50% of those sampled contained 1 or less other openings within a 0.5-km radius (Appendix C21), and 60% contained 4 or less within a 1.0-km radius (Appendix C22).

From 28 to 41% of the openings within CPC, LSH, GSH, and STP divisions were within 100 m of another managed opening (Appendix B23). Variation associated with proximity of openings was more pronounced at the district level (Appendix C23). Here, the frequency of openings which were within 100 m of another was twice as high in Murphysboro and Vienna than in Elizabethtown and Jonesboro districts. These differences were not as evident when only the density of openings in sampled areas was examined (Appendix C21, C22).

Current Treatment

Approximately 7 to 10 years ago, many areas designated or created as wildlife openings in the SNF were seeded to fescue, possibly for erosion control or to achieve some vegetative diversity in otherwise wooded settings. Forest Service personnel subsequently recognized fescue as low quality habitat, and present management emphasizes renovation (discing and seeding) of openings that contain undesirable vegetation (i.e. fescue) to a mixture of domesticated legumes (red, white, ladino clover), sweet clover, Korean lespedeza, and orchard grass.

Management of wildlife openings in the SNF varies by ranger district with respect to method and frequency of treatment. Currently,

the Vienna, Elizabethtown, and Jonesboro districts are divided into 4 work areas and Murphysboro 3; thus, management of any given area within these districts is under a 4- and 3-year rotation, respectively. Openings within a work area scheduled for treatment are inventoried and associated vegetation identified. Those openings containing desirable vegetation are usually burned, mowed, or treated with Tordon 10K to control woody growth. Fescue openings, most common in the Elizabethtown and Vienna districts, are usually burned in spring to remove duff and stimulate new growth. Roundup is then applied to kill emerging vegetation. Following this, a heavy disc is used to create a 20-cm layer of disturbed soil. If discing is in spring, then seeding with legumes immediately follows; if discing is in late summer or fall, winter wheat or rye is seeded as a nurse crop and legumes broadcast in late winter.

Of the 4 ranger districts, only Vienna treats openings annually. Openings in 1 of the 4 work areas are either disced and seeded, burned, mowed, or treated with Tordon 10K; openings in the other 3 areas are mowed. If openings are disced and seeded in spring, they are mowed in fall to retard weedy competition with planted legumes. The high frequency of favorable ragweed-dominated openings in the CPC division of the Vienna district resulted from recent efforts to establish legumes.

The Elizabethtown district is managed similarly, except that while 1 work area is renovated, only 1 other is mowed. The following year, openings in a new area are renovated and all openings renovated

the previous year are mowed. Again, this is done to stimulate legume production. A rotation thus exists whereby individual openings are either renovated, burned, or chemically treated every 4th year, and mowed at least every 2nd year.

The Jonesboro district contains 4 work areas thus openings should theoretically be renovated, mowed, or chemically treated every 4 years. In practice, however, many openings have gone untreated beyond the 4-year rotation period resulting in a high frequency of sassafras-persimmon-sumac dominated openings. However, recent efforts have been made to catch up on overdue mowing, and recently renovated openings have undergone follow-up mowing to stimulate legume growth.

The Murphysboro district contains 3 work areas with openings on a planned 3-year treatment rotation. As in the Jonesboro district, however, many openings have gone untreated beyond this period resulting in the invasion of woody vegetation. More recently, this district has increased mowing of neglected areas.

Approximately 106 openings in the Vienna and Murphysboro districts were scheduled to be managed by the Illinois Department of Conservation when this project was initiated in 1984. However, 27 of these could not be treated because of access problems, 2 were planted to pines by the Forest Service, and 14 received only non-soil disturbing treatments because they were within a RARE II area. State management of the remaining openings consisted of spring and/or summer planting of cereal grains; summer and/or fall mowing and/or discing; fall burning by the Forest Service; and fall planting of winter wheat. Individual

openings received one or a combination of these treatments with some being left fallow the year following discing. Food plots of cereal grains and/or winter wheat generally comprised only a portion of openings larger than 0.4 ha.

Miscellaneous Observations

Approximately 609 openings were visited by researchers during this project. Of this total, 20 (3.3%)(5 in each district) were serving as log landings. An additional 21 (3.4%) had gravel roads running through them; 9 of these were so disturbed that they have been removed from the roster of managed openings. In all, 44 (7.2%) openings visited during this study have been dropped from future management considerations (all in the Murphysboro district). However, 20 of these were within a RARE II area.

DISCUSSION

The actual and potential contribution of openings to wildlife in the SNF is dependent upon characteristics of a given opening as well as those of the surrounding habitat. Openings examined during this study represented a variety of shapes and sizes, and no obvious pattern of placement was evident with regard to aspect and slope. Most were elongated in shape, from 0.3 to 0.4 ha in size, and associated with upland, ridge top, or hillside soil types. Many newer openings, and those being constructed, are somewhat larger (1-2 ha). Vegetation within the opening depended on the type and frequency of treatment; most often, there was little or no transitional zone between opening vegetation and the surrounding forest.

Land use and forest types surrounding individual openings were related primarily to topography, soil quality, and ownership patterns. Openings dominated by mature oak-hickory stands were most common as expected as this forest type comprises approximately 65% of the SNF. Ridge top openings surrounded by oak-hickory or openings in southern pine stands on narrow ridge tops surrounded by large oak-hickory areas predominated. However, there also existed a substantial number of openings partially or totally surrounded by large stands of southern pine. With proper management, these stands and their associated openings could provide quality habitat for wildlife including upland game. However, this potential is not presently realized. High tree densities, excessive honeysuckle understory, and infrequent, sporadic burning have resulted in pine stands that lack a suitable understory for most wildlife species.

Private lands near wildlife openings also influence their management and potential contribution to wildlife. Topography and soil characteristics of southern Illinois are more conducive to forage than to rowcrop production; hence a pattern of Forest Service property adjacent to pastures and hayfields is not uncommon. Most openings in the SNF are, in fact, within 800 m of some form of agriculture and even closer to some other non-forested habitat. Depending on specific goals and objectives, this proximity to non-forested areas could indicate that no further opening construction is needed; some openings are/were unnecessary; or, it could suggest a management strategy aimed at those wildlife species characteristic of more open habitats. Overall management efforts would be enhanced if the State

of Illinois were to capitalize on management opportunities in selected private inholdings within the SNF purchase boundary.

In addition to habitat considerations, accessibility of openings also affects their use by both humans and wildlife. Access limitations exist within certain compartments of all districts. Abuse by 3- and 4-wheel drive vehicles, and horses, have made many trails impassable except for the aforementioned conveyances. Trails to isolated openings are often so heavily rutted that wet conditions make them inaccessible unless a 4-wheel drive vehicle or tractor is used. Given that most opening renovation and treatment is contracted to private individuals, adequate access is essential otherwise contractors may not wish to risk their equipment, resulting in uneven or improperly-timed treatment. On the other hand, many openings are in close proximity to good, all-weather roads; a situation that creates a different set of problems or considerations for management. Such openings often receive heavy recreational use which can impact intended wildlife utilization. For example, many openings close to gravel roads in the Jonesboro district are used as campsites during the turkey season. Some openings are bisected by Forest Service gravel roads apparently created for timber harvest and management. Future impact could be minimized if such roads were placed along the edge or inside the adjacent timber stand. One way to mitigate existing situations of this kind would be to plant fruit trees or shrubs along both sides of the roads. This would provide food for wildlife and, more importantly, reduce opportunities for poaching from vehicles.

In addition to access roads, timber harvesting also affects openings as when they are used as log landings. During harvest operations, nearby wildlife openings are obviously convenient areas for stacking logs; the practice was observed in all districts. However, consideration should also be given to the primary reason for the existence of such openings as well as the cost of their construction and maintenance. In some cases, temporary use of openings as log landings might not be perceived as a problem; however, when desirable vegetation is affected, or when the number of openings is limited, the practice is not acceptable. It should be noted that recent clearcuts do not supply habitat comparable to that of herbaceous openings. Slash and resprouting in these areas usually limits their utility to a few species.

In some instances, the best policy for opening management may be simply to maintain existing native vegetation. A relatively large number of openings were found to be dominated by, or contained remnants of, native warm-season grasses such as little bluestem, big bluestem, and Indian grass, often associated with various prairie forbs. These openings were most prevalent in the Shawnee Hills and Cretaceous Hills divisions of the Vienna and Elizabethtown districts, and also in the Southern Till Plain portion of the Murphysboro district near Lake Kinkaid. Areas of this kind are not only aesthetically pleasing, but also provide excellent seasonal habitat for certain wildlife species. The need to identify such sites in future inventories,

and to alert contractors to their existence, cannot be overemphasized. Much time and effort is presently spent in establishing warm-season plots; however, the number of such openings could be substantially increased if existing openings characterized by native warm-season grasses were identified and periodically burned. Destruction of such openings by renovation or by utilizing them as log landings is inexcusable.

Keeping track of sensitive openings will be made easier by the computerized storage and retrieval system developed in Job 2. This system, which contains detailed, pertinent information on individual openings and their surrounding habitats, should prove beneficial in future management of all wildlife openings in the SNF. Areal and constraint extraction capabilities will permit managers to identify openings that meet selected criteria or sets of criteria thereby facilitating the matching of openings with particular management strategies and/or goals. Optimizing the use of openings by gearing management to their greatest potential contribution would go a long way toward justifying the cost and effort associated with the program.

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Appendix A. Opening locations.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	1	1	11S	6E	2	SE
V	1	2	11S	6E	1	SW
V	1	3	11S	6E	1	SW
V	1	4	11S	6E	1	SE
V	1	5	11S	6E	1	SE
V	1	6	11S	6E	1	NW
V	1	7	11S	6E	1	NW
V	1	8	10S	6E	25	SW
V	1	9	10S	6E	25	SW
V	1	10	10S	6E	25	SW
V	1	11	10S	6E	36	NE
V	1	12	10S	6E	36	NE
V	3	1	11S	6E	5	SW
V	3	2	11S	6E	5	NW
V	3	3	11S	6E	5	NW
V	3	4	11S	6E	5	NW
V	3	5	11S	6E	5	NW
V	3	6	11S	6E	5	NW
V	3	7	11S	6E	6	NE
V	4	1	10S	6E	31	NE
V	4	2	10S	6E	31	NE
V	4	3	10S	6E	31	NE
V	4	4	10S	6E	30	SE
V	4	5	10S	6E	32	NW
V	4	6	10S	6E	32	NE
V	4	7	10S	6E	29	SE
V	4	8	10S	6E	29	SE
V	5	1	10S	6E	31	NW
V	5	2	10S	6E	31	SE
V	5	3	10S	6E	31	SE
V	5	4	10S	6E	31	SW
V	5	5	10S	6E	31	SW
V	5	6	11S	6E	6	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	5	7	11S	6E	6	NW
V	5	8	11S	6E	6	NW
V	5	9	11S	6E	6	SW
V	5	10	11S	6E	6	SW
V	5	11	10S	5E	36	SE
V	5	12	11S	5E	1	NE
V	5	13	11S	5E	1	NE
V	5	14	11S	5E	1	NE
V	5	15	11S	5E	1	NE
V	7	1	11S	5E	11	SE
V	7	2	11S	5E	11	NE
V	7	3	11S	5E	2	SE
V	7	4	11S	5E	2	SE
V	7	5	11S	5E	2	SE
V	7	6	11S	5E	2	SW
V	7	7	11S	5E	2	SE
V	7	8	11S	5E	2	SE
V	7	9	11S	5E	1	SW
V	7	10	11S	5E	1	SW
V	9	1	11S	5E	15	NE
V	9	2	11S	5E	11	SW
V	9	3	11S	5E	10	SE
V	9	4	11S	5E	10	SE
V	9	5	11S	5E	10	SE
V	9	6	11S	5E	10	NE
V	9	7	11S	5E	10	NE
V	9	8	11S	5E	10	NW
V	9	9	11S	5E	10	NW
V	9	10	11S	5E	10	SW
V	9	11	11S	5E	3	SW
V	9	12	11S	5E	10	NW
V	9	13	11S	5E	10	NW
V	12	1	11S	4E	1	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	12	2	11S	4E	1	SW
V	12	3	11S	4E	1	SW
V	12	4	11S	4E	11	NE
V	14	1	11S	5E	28	NW
V	14	2	11S	5E	21	SE
V	14	3	11S	5E	21	SE
V	14	4	11S	5E	21	NE
V	14	5	11S	5E	22	NW
V	14	6	11S	5E	22	NE
V	14	7	11S	5E	22	SE
V	14	8	11S	5E	28	NW
V	14	9	11S	5E	15	SW
V	15	1	11S	5E	22	NE
V	15	2	11S	5E	22	NE
V	15	3	11S	5E	15	SE
V	15	4	11S	5E	15	SE
V	15	5	11S	5E	15	SE
V	15	6	11S	5E	14	SW
V	15	7	11S	5E	23	NW
V	15	8	11S	5E	14	SW
V	15	9	11S	5E	14	NW
V	15	11	11S	5E	14	SW
V	15	12	11S	5E	14	SE
V	15	13	11S	5E	14	SE
V	15	14	11S	5E	13	SW
V	15	15	11S	5E	13	SW
V	15	16	11S	5E	14	SW
V	15	17	11S	5E	23	NE
V	15	18	11S	5E	23	NE
V	15	19	11S	5E	23	NE
V	15	20	11S	5E	22	NE
V	15	21	11S	5E	23	NW
V	15	22	11S	5E	23	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	15	23	11S	5E	23	NW
V	15	24	11S	5E	23	SW
V	15	25	11S	5E	22	SE
V	15	26	11S	5E	23	SW
V	16	1	11S	6E	19	SW
V	16	2	11S	6E	19	SW
V	16	3	11S	6E	19	SW
V	16	4	11S	6E	19	SW
V	16	5	11S	6E	19	SW
V	16	6	11S	6E	19	NE
V	16	7	11S	6E	19	NE
V	16	8	11S	5E	13	NE
V	16	10	11S	6E	18	NW
V	17	1	11S	5E	23	SE
V	17	2	11S	5E	23	SE
V	17	3	11S	5E	23	SE
V	17	4	11S	5E	24	SW
V	17	6	11S	5E	24	NW
V	17	8	11S	5E	24	SW
V	17	9	11S	5E	24	NE
V	17	11	11S	5E	24	SW
V	17	12	11S	5E	24	SW
V	17	13	11S	5E	24	SE
V	17	15	11S	5E	24	SE
V	17	17	11S	5E	24	NW
V	17	18	11S	5E	24	SE
V	17	19	11S	5E	24	SE
V	17	20	11S	5E	25	NE
V	17	21	11S	5E	25	NE
V	18	1	11S	6E	22	SW
V	18	2	11S	6E	22	SW
V	19	1	11S	6E	15	NE
V	19	2	11S	6E	15	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	19	3	11S	6E	15	SE
V	19	4	11S	6E	15	SW
V	19	5	11S	6E	15	SW
V	19	6	11S	6E	15	SW
V	19	7	11S	6E	15	SW
V	19	8	11S	6E	15	SW
V	19	9	11S	6E	15	SW
V	21	1	11S	6E	23	NW
V	21	2	11S	6E	22	NE
V	21	3	11S	6E	15	SE
V	21	4	11S	6E	22	SE
V	21	5	11S	6E	22	NE
V	21	6	11S	6E	22	NW
V	21	7	11S	6E	22	SE
V	21	8	11S	6E	22	SE
V	21	9	11S	6E	22	SW
V	21	10	11S	6E	22	SW
V	21	11	11S	6E	22	SE
V	21	12	11S	6E	22	SE
V	21	13	11S	6E	22	SE
V	21	14	11S	6E	22	SE
V	21	15	11S	6E	22	SE
V	21	16	11S	6E	27	NE
V	21	17	11S	6E	27	NE
V	21	18	11S	6E	26	NW
V	21	19	11S	6E	26	NW
V	21	20	11S	6E	27	NE
V	21	21	11S	6E	27	NE
V	21	22	11S	6E	27	NE
V	21	23	11S	6E	27	SE
V	21	24	11S	6E	27	SE
V	21	25	11S	6E	23	SW
V	22	1	11S	6E	26	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	22	2	11S	6E	23	SW
V	22	3	11S	6E	23	SE
V	22	4	11S	6E	26	NW
V	22	5	11S	6E	23	SE
V	22	6	11S	6E	26	NE
V	22	7	11S	6E	25	NW
V	22	8	11S	6E	25	NW
V	22	9	11S	6E	26	NE
V	22	10	11S	6E	26	NE
V	22	11	11S	6E	26	NW
V	22	12	11S	6E	27	SE
V	23	1	11S	6E	28	NE
V	23	2	11S	6E	28	NE
V	23	3	11S	6E	28	NE
V	23	4	11S	6E	27	NW
V	24	1	11S	6E	26	SE
V	24	2	11S	6E	35	NE
V	24	3	11S	6E	34	NE
V	24	4	11S	6E	34	NE
V	24	5	11S	6E	34	NE
V	24	6	11S	6E	34	NE
V	24	7	11S	6E	35	NW
V	24	8	11S	6E	35	NW
V	24	9	11S	6E	26	SW
V	25	1	12S	6E	1	NE
V	25	2	12S	6E	1	NW
V	25	3	12S	6E	1	SW
V	25	4	11S	6E	36	SE
V	25	5	11S	6E	36	NE
V	25	6	11S	6E	36	SE
V	25	7	11S	6E	36	SE
V	26	1	12S	6E	4	NW
V	26	2	12S	6E	4	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	26	3	12S	6E	4	NW
V	26	4	12S	6E	4	NW
V	26	5	12S	6E	4	NW
V	26	6	12S	6E	4	NW
V	26	7	11S	6E	33	SW
V	26	8	11S	6E	33	SW
V	27	1	11S	6E	31	SE
V	27	2	11S	6E	31	NE
V	29	1	12S	5E	11	NW
V	29	2	12S	5E	10	NE
V	29	3	12S	5E	10	NE
V	29	7	12S	5E	2	SW
V	29	8	12S	5E	2	SW
V	29	9	12S	5E	2	SW
V	29	10	12S	5E	2	SE
V	29	11	12S	5E	2	SE
V	29	14	12S	5E	12	NW
V	29	16	12S	5E	11	SE
V	29	17	12S	5E	11	SE
V	29	18	12S	5E	11	NE
V	29	20	12S	5E	11	NE
V	29	22	12S	5E	11	SW
V	29	25	12S	5E	11	NW
V	29	26	12S	5E	10	SE
V	29	27	12S	5E	11	SW
V	29	28	12S	5E	11	SW
V	30	1	11S	5E	35	SW
V	30	2	11S	5E	35	NE
V	30	3	11S	5E	27	NE
V	31	1	11S	5E	28	SW
V	31	2	11S	5E	28	SW
V	31	3	11S	5E	28	NW
V	31	4	11S	5E	28	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	31	5	11S	5E	27	SW
V	32	1	12S	5E	4	SW
V	32	2	12S	5E	5	SE
V	32	3	12S	5E	5	SE
V	32	4	11S	5E	32	SE
V	32	5	11S	5E	32	SE
V	32	6	11S	5E	33	SW
V	32	7	11S	5E	33	SW
V	32	8	11S	5E	33	SW
V	32	9	11S	5E	33	NW
V	33	1	12S	5E	6	NW
V	33	2	12S	5E	6	NW
V	33	3	12S	5E	6	NW
V	33	4	12S	5E	6	NE
V	33	5	12S	5E	6	SE
V	33	6	12S	5E	5	SE
V	33	7	12S	5E	5	SE
V	33	8	11S	5E	31	NE
V	33	9	11S	5E	31	NE
V	34	1	11S	4E	36	SW
V	34	2	11S	4E	36	SW
V	34	3	11S	4E	35	SE
V	34	4	11S	4E	35	SW
V	34	5	11S	4E	35	SW
V	34	6	12S	4E	2	NW
V	34	7	12S	4E	2	NW
V	34	10	11S	4E	26	SE
V	34	11	11S	4E	35	NE
V	35	1	12S	4E	9	NE
V	35	2	12S	4E	9	NE
V	35	3	12S	4E	9	NE
V	35	4	12S	4E	10	NW
V	35	5	12S	4E	4	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	35	6	12S	4E	4	SW
V	35	7	12S	4E	4	SW
V	35	8	12S	4E	3	NW
V	36	1	12S	3E	13	NE
V	36	2	12S	3E	13	NE
V	36	3	12S	3E	13	NE
V	36	4	12S	3E	12	SE
V	36	5	12S	3E	12	SE
V	36	6	12S	4E	18	NW
V	36	7	12S	3E	13	NE
V	36	8	12S	4E	18	NW
V	36	9	12S	4E	7	SW
V	36	10	12S	4E	18	NE
V	36	11	12S	4E	18	NW
V	36	12	12S	4E	7	SE
V	38	1	12S	4E	1	NE
V	38	2	12S	4E	10	NE
V	38	3	12S	4E	10	NE
V	38	4	12S	4E	1	SE
V	38	5	12S	4E	1	SE
V	38	6	12S	4E	1	SW
V	38	7	12S	4E	1	NW
V	38	8	12S	4E	1	NW
V	38	9	12S	4E	2	SW
V	38	10	12S	4E	2	SW
V	38	11	12S	4E	1	SW
V	38	12	12S	4E	11	NW
V	38	13	12S	4E	11	NW
V	38	14	12S	4E	11	NW
V	41	1	12S	5E	16	NE
V	41	2	12S	5E	16	NE
V	41	3	12S	5E	16	NE
V	41	4	12S	5E	16	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	41	5	12S	5E	9	SW
V	43	1	12S	5E	23	NW
V	43	2	12S	5E	15	SE
V	43	3	12S	5E	15	SE
V	43	4	12S	5E	14	SW
V	43	5	12S	5E	14	NE
V	43	6	12S	5E	14	NW
V	43	7	12S	5E	14	NE
V	43	8	12S	5E	14	NW
V	43	9	12S	5E	14	NW
V	47	1	12S	6E	14	SE
V	48	1	12S	6E	23	NE
V	48	2	12S	6E	13	SW
V	48	3	12S	6E	14	SE
V	48	4	12S	6E	13	SW
V	48	5	12S	6E	13	SW
V	48	6	12S	6E	13	SW
V	48	7	12S	6E	13	SW
V	48	8	12S	6E	13	NW
V	48	10	12S	6E	11	SE
V	48	11	12S	6E	12	NE
V	48	12	12S	6E	12	NE
V	48	13	12S	6E	12	SE
V	50	1	12S	6E	22	NW
V	51	1	12S	6E	29	NE
V	54	1	12S	6E	29	NE
V	54	2	12S	6E	29	NE
V	54	3	12S	6E	29	SE
V	54	4	12S	6E	30	SE
V	54	5	12S	6E	30	SE
V	55	1	13S	6E	4	NE
V	55	2	13S	6E	4	NE
V	55	3	13S	6E	4	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	55	4	13S	6E	4	SE
V	55	5	13S	6E	4	SE
V	55	6	13S	6E	4	SE
V	55	7	13S	6E	9	NE
V	55	8	13S	6E	9	NW
V	55	9	13S	6E	9	NW
V	55	10	13S	6E	9	NE
V	55	11	13S	5E	9	GE
V	55	12	13S	6E	9	SE
V	55	13	13S	6E	5	NW
V	55	14	13S	6E	5	NW
V	56	1	13S	6E	3	NW
V	56	2	13S	6E	3	NW
V	56	3	13S	6E	3	SW
V	56	4	13S	6E	3	SW
V	56	5	13S	6E	3	SW
V	56	6	13S	6E	3	SE
V	56	7	13S	6E	3	SE
V	56	8	13S	6E	3	SW
V	56	9	13S	6E	3	SW
V	56	10	13S	6E	10	NW
V	56	11	13S	6E	3	NE
V	56	12	13S	6E	3	NE
V	56	13	13S	6E	3	NE
V	56	14	13S	6E	2	NW
V	56	15	13S	6E	2	NW
V	56	16	13S	6E	2	NW
V	56	17	13S	6E	2	SW
V	56	18	13S	6E	2	SW
V	56	19	13S	6E	3	SE
V	56	20	13S	6E	3	SE
V	56	21	13S	6E	3	SE
V	56	22	12S	6E	34	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	56	23	12S	6E	33	SE
V	56	24	13S	6E	3	NW
V	60	1	13S	5E	10	SE
V	60	3	13S	5E	10	NE
V	61	1	13S	5E	10	NW
V	61	2	13S	5E	10	NW
V	61	3	13S	5E	10	NE
V	61	4	13S	5E	10	NE
V	61	5	13S	5E	3	SW
V	61	6	13S	5E	15	NE
V	61	7	13S	5E	15	NE
V	61	8	13S	5E	15	NW
V	61	9	13S	5E	10	SE
V	62	1	13S	5E	7	SE
V	62	2	13S	5E	8	NW
V	65	3	13S	4E	26	NE
V	65	4	13S	4E	26	NE
V	65	6	13S	4E	24	SW
V	65	7	13S	4E	24	SW
V	65	9	13S	4E	23	SE
V	65	10	13S	4E	23	SE
V	65	11	13S	4E	23	SE
V	65	13	13S	4E	24	NE
V	65	14	13S	4E	24	NE
V	72	1	14S	5E	24	SE
V	72	2	14S	5E	24	SE
V	72	3	14S	5E	13	SE
V	75	1	14S	5E	26	NW
V	75	2	14S	5E	26	NE
V	75	3	14S	5E	26	SE
V	75	4	14S	5E	35	NE
V	75	8	14S	5E	25	NW
V	75	9	14S	5E	25	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	75	10	14S	5E	24	SW
V	75	11	14S	5E	25	NW
V	75	12	14S	5E	25	NW
V	75	14	14S	5E	25	NE
V	75	15	14S	5E	24	SE
V	75	16	14S	5E	24	SE
V	75	17	14S	5E	24	SE
V	75	19	14S	5E	25	SE
V	75	21	14S	5E	25	SE
V	75	22	14S	5E	25	NE
V	76	1	14S	6E	32	SE
V	76	2	14S	6E	32	SE
V	76	3	14S	6E	32	SE
V	76	4	14S	6E	30	SW
V	77	1	15S	6E	3	NW
V	77	2	15S	6E	3	NW
V	78	2	15S	6E	6	SE
V	78	3	15S	6E	7	NE
V	78	4	15S	6E	8	NW
V	78	5	15S	6E	8	NW
V	78	6	15S	6E	8	SE
V	78	7	15S	6E	8	SE
V	78	8	15S	6E	8	NE
V	78	9	15S	6E	8	NE
V	78	10	15S	6E	5	SE
V	78	11	15S	6E	5	SW
V	78	12	15S	6E	5	NW
V	78	13	15S	6E	6	NE
V	78	14	15S	6E	6	NE
V	78	15	15S	6E	5	SE
V	79	2	15S	6E	9	NW
V	79	3	15S	6E	10	NW
V	79	4	15S	6E	10	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	79	5	15S	6E	10	NE
V	79	6	15S	6E	3	SE
V	79	7	15S	6E	3	SW
V	79	8	15S	6E	3	SE
V	79	9	15S	6E	3	SW
V	79	10	15S	6E	9	NE
V	79	11	15S	6E	4	SE
V	79	12	15S	6E	4	SE
V	79	13	15S	6E	9	SW
V	79	14	15S	6E	9	SE
V	79	15	15S	6E	9	NE
V	79	16	15S	6E	10	SW
V	80	1	15S	6E	11	NE
V	80	2	15S	6E	11	SE
V	82	1	15S	6E	21	SE
V	82	2	15S	6E	21	SE
V	82	3	15S	6E	22	NW
V	82	4	15S	6E	22	NW
V	82	5	15S	6E	22	NW
V	82	6	15S	6E	22	SE
V	82	7	15S	6E	22	SE
V	82	8	15S	6E	22	SE
V	82	9	15S	6E	22	NE
V	82	10	15S	6E	15	SE
V	82	11	15S	6E	15	SE
V	82	12	15S	6E	15	SE
V	82	13	15S	6E	15	SE
V	82	14	15S	6E	15	NE
V	82	15	15S	6E	15	NE
V	82	16	15S	6E	22	NE
V	82	17	15S	6E	22	NW
V	82	18	15S	6E	22	SW
V	82	19	15S	6E	21	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
V	82	20	15S	6E	22	SE
V	83	1	15S	6E	23	NW
V	83	2	15S	6E	14	SW
V	83	5	15S	6E	14	SW
V	83	6	15S	6E	14	SW
V	83	8	15S	6E	14	SE
V	83	9	15S	6E	14	SE
V	83	10	15S	6E	23	NE
V	83	11	15S	6E	24	NW
V	83	12	15S	6E	13	SW
V	83	14	15S	6E	24	NE
V	83	16	15S	6E	13	SE
V	83	17	15S	6E	24	NE
V	83	18	15S	6E	13	SW
V	83	19	15S	6E	13	SW
V	83	25	15S	6E	13	NW
V	83	27	15S	6E	14	NE
V	83	28	15S	6E	14	NE
V	83	30	15S	6E	11	SE
V	84	1	15S	6E	26	SE
V	84	2	15S	6E	35	NE
V	84	3	15S	6E	35	NE
V	84	4	15S	6E	35	NE
V	84	5	15S	6E	26	SW
V	84	6	15S	6E	26	SW
V	84	7	15S	6E	26	SW
V	84	8	15S	6E	26	SW
V	85	1	15S	6E	25	NE
V	85	2	15S	6E	24	SE
V	85	3	15S	6E	24	SE
V	85	5	15S	7E	30	NW
V	85	7	15S	7E	30	NW
V	85	8	15S	7E	30	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	85	9	15S	7E	30	SE
V	85	10	15S	7E	30	SW
V	85	12	15S	7E	30	SW
V	85	13	15S	7E	31	NW
V	85	14	15S	7E	31	NW
V	85	15	15S	7E	31	SW
V	85	16	15S	7E	31	SE
V	85	17	15S	7E	31	NW
V	85	18	15S	7E	31	NW
V	85	19	15S	7E	31	NW
V	85	20	15S	7E	31	NW
V	85	21	15S	7E	31	SE
V	85	22	15S	6E	25	SW
V	85	23	15S	6E	36	NW
V	89	3	12S	3E	8	NW
V	92	1	12S	3E	5	SE
V	92	2	12S	3E	5	NE
V	94	1	11S	3E	17	SE
V	94	2	11S	3E	17	SE
V	94	3	11S	3E	17	SE
V	94	4	11S	3E	17	SW
V	95	1	11S	3E	15	SW
V	95	2	11S	3E	16	SE
V	95	4	11S	3E	16	SE
V	95	5	11S	3E	15	SW
V	95	6	11S	3E	15	SW
V	95	7	11S	3E	15	SW
V	95	9	11S	3E	16	SE
V	95	10	11S	3E	16	SE
V	95	11	11S	3E	16	SE
V	96	1	11S	3E	10	SW
V	96	2	11S	3E	10	SW
V	96	3	11S	3E	10	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
V	96	4	11S	3E	10	SE
V	96	5	11S	3E	10	NE
V	96	6	11S	3E	10	SE
V	96	7	11S	3E	10	SE
V	96	8	11S	3E	10	NE
V	96	9	11S	3E	10	NE
V	96	10	11S	3E	11	SW
V	96	11	11S	3E	11	SW
V	105	1	11S	3E	12	NE
J	51	1	11S	2W	16	SW
J	52	1	11S	2W	29	NE
J	53	1	11S	2W	20	NW
J	53	2	11S	2W	20	NW
J	53	3	11S	2W	20	NW
J	55	1	11S	2W	30	NW
J	55	2	11S	2W	19	NW
J	55	3	11S	2W	18	SW
J	55	5	11S	2W	19	NW
J	55	6	11S	2W	30	NW
J	55	7	11S	3W	24	SE
J	55	8	11S	2W	30	NW
J	55	9	11S	2W	30	NW
J	55	10	11S	2W	19	SW
J	55	11	11S	2W	18	SW
J	58	1	11S	3W	34	NE
J	59	1	11S	3W	23	SW
J	60	1	11S	3W	35	NE
J	61	2	11S	3W	35	SW
J	61	3	11S	3W	35	SW
J	61	4	11S	3W	34	NE
J	62	1	11S	3W	35	SE
J	62	2	11S	3W	36	SW
J	62	3	11S	3W	35	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
J	65	1	12S	2W	10	NE
J	65	2	12S	2W	10	NE
J	65	3	12S	2W	3	SE
J	65	4	12S	2W	3	NE
J	65	5	11S	2W	34	SE
J	65	6	11S	2W	34	SE
J	65	7	11S	2W	34	SE
J	65	8	11S	2W	34	NE
J	66	1	11S	3W	35	NW
J	69	1	12S	2W	15	NW
J	71	1	12S	2W	28	SW
J	71	2	12S	2W	28	SW
J	71	3	12S	2W	28	SW
J	71	4	12S	2W	28	SW
J	71	5	12S	2W	29	SE
J	71	6	12S	2W	29	SE
J	73	1	13S	2W	4	NW
J	73	2	13S	2W	4	NW
J	74	3	12S	2W	33	NE
J	74	4	12S	2W	34	SW
J	74	5	12S	2W	34	SW
J	74	7	12S	2W	34	SE
J	74	8	12S	2W	34	SW
J	74	9	13S	2W	3	NW
J	74	10	13S	2W	4	NE
J	74	11	13S	2W	4	NE
J	74	12	12S	2W	34	SW
J	75	1	13S	2W	2	SW
J	77	1	13S	2W	10	NW
J	77	2	13S	2W	10	NW
J	77	3	13S	2W	10	NW
J	77	4	13S	2W	10	SE
J	77	5	13S	2W	10	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
J	77	6	13S	2W	15	NE
J	77	8	13S	2W	16	NW
J	77	9	13S	2W	9	NE
J	77	10	13S	2W	9	NE
J	77	11	13S	2W	15	NE
J	79	2	13S	2W	16	NE
J	80	1	13S	2W	22	SW
J	80	2	13S	2W	22	SW
J	81	1	13S	2W	22	NW
J	81	2	13S	2W	22	SE
J	81	3	13S	2W	23	SW
J	81	4	13S	2W	22	NW
J	81	5	13S	2W	27	SW
J	81	6	13S	2W	27	SW
J	81	7	13S	2W	27	SE
J	82	1	13S	2W	26	SE
J	82	2	13S	2W	26	SE
J	82	3	13S	2W	26	SE
J	82	4	13S	2W	35	SE
J	84	1	13S	2W	28	SE
J	84	2	13S	2W	34	NW
J	84	3	13S	2W	33	NW
J	84	4	14S	2W	4	NW
J	84	5	13S	2W	33	NE
J	85	1	13S	2W	32	SE
J	85	2	13S	2W	32	SW
J	85	3	13S	2W	32	SW
J	86	1	14S	2W	8	NW
J	86	2	14S	2W	8	NW
J	86	3	14S	2W	5	SE
J	86	4	14S	2W	5	SE
J	86	5	14S	2W	5	SW
J	86	6	14S	2W	4	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
J	86	7	14S	2W	4	NW
J	86	8	14S	2W	5	NE
J	86	9	14S	2W	5	NE
J	87	1	14S	2W	8	SW
J	87	2	14S	2W	7	SE
J	87	3	14S	2W	8	NW
J	87	4	14S	2W	7	NE
J	87	5	14S	2W	7	NE
J	88	3	14S	2W	9	SE
J	88	6	14S	2W	9	NE
J	89	1	14S	2W	11	NE
J	89	2	14S	2W	11	NE
J	90	1	14S	2W	14	NE
J	90	2	14S	2W	14	NW
J	90	4	14S	2W	15	NE
J	90	5	14S	2W	14	SW
J	90	6	14S	2W	14	SE
J	90	7	14S	2W	14	SE
J	90	10	14S	2W	13	SW
J	91	1	14S	2W	23	SE
J	91	2	14S	2W	23	SE
J	91	3	14S	2W	23	NE
J	91	4	14S	2W	23	NE
J	91	5	14S	2W	14	SW
J	91	6	14S	2W	14	SW
J	91	7	14S	2W	23	NW
J	92	3	14S	2W	22	SW
J	92	4	14S	2W	22	SE
J	92	5	14S	2W	22	NE
J	92	6	14S	2W	15	SW
J	92	7	14S	2W	15	SW
J	92	8	14S	2W	15	SW
J	92	10	14S	2W	22	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
J	92	11	14S	2W	22	SW
J	92	13	14S	2W	23	NW
J	96	1	14S	3W	24	NW
J	96	2	14S	3W	24	NW
J	96	3	14S	3W	24	NW
J	96	4	14S	3W	24	NW
J	96	5	14S	3W	24	NW
J	96	6	14S	3W	24	NW
J	96	7	14S	3W	24	NW
J	96	8	14S	3W	24	NW
J	96	9	14S	3W	13	SW
J	96	10	14S	3W	13	SE
J	96	11	14S	3W	13	SE
J	96	12	14S	2W	18	NW
J	96	13	14S	2W	18	NW
J	96	14	14S	2W	18	NW
J	96	15	14S	3W	13	NE
J	97	1	14S	2W	18	SW
J	98	1	14S	3W	23	NE
J	100	1	14S	3W	33	SE
J	100	2	14S	3W	33	SE
J	100	3	14S	3W	34	SE
J	100	4	14S	3W	34	SE
J	100	5	14S	3W	34	SE
J	100	6	14S	3W	34	SE
J	100	7	14S	3W	34	SW
J	100	8	14S	3W	34	SE
J	100	9	15S	3W	3	SE
J	100	10	15S	3W	3	SW
J	101	1	14S	3W	36	SW
J	101	2	14S	3W	35	SE
J	101	3	14S	3W	36	SW
J	102	1	14S	2W	31	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
J	102	2	14S	3W	25	SE
J	102	3	14S	3W	25	SE
J	102	4	14S	3W	36	SE
J	102	5	14S	2W	30	SW
J	102	6	14S	2W	30	SW
J	102	7	14S	3W	36	NE
J	103	3	14S	2W	29	NW
J	103	6	14S	2W	29	NE
J	103	8	14S	2W	29	SE
J	103	10	14S	2W	21	SW
J	103	12	14S	2W	29	SE
J	103	13	14S	2W	32	NW
J	104	2	14S	2W	32	SE
J	104	3	14S	2W	32	SE
J	104	4	14S	2W	32	SE
J	105	1	14S	2W	33	NE
J	105	2	14S	2W	34	NW
J	105	3	14S	2W	33	SE
J	105	4	14S	2W	33	SE
J	105	5	14S	2W	33	SE
J	105	6	14S	2W	27	SE
J	105	7	14S	2W	33	NE
J	106	1	14S	2W	35	SE
J	106	2	14S	2W	35	SW
J	106	3	14S	2W	35	SW
J	106	4	14S	2W	35	NW
J	107	1	15S	2W	3	NE
J	107	2	15S	2W	3	SE
J	108	1	14S	2W	32	SW
J	108	2	14S	2W	31	SE
J	108	3	15S	2W	8	NW
J	108	4	15S	2W	6	SE
J	108	5	15S	2W	6	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
J	108	6	15S	2W	6	SE
J	108	7	15S	2W	6	NE
J	108	8	15S	2W	6	NE
J	108	9	14S	2W	31	SE
J	108	10	15S	2W	5	SW
J	109	1	15S	2W	8	SE
J	109	2	15S	2W	8	NE
J	109	3	15S	2W	8	NE
J	109	4	15S	2W	8	SE
J	109	5	15S	2W	8	SE
J	109	6	15S	2W	8	SW
J	109	7	15S	2W	18	NE
J	109	8	15S	2W	18	NE
J	109	9	15S	2W	18	NE
J	109	10	15S	2W	17	NW
J	109	11	15S	2W	17	NW
J	109	13	15S	2W	17	NE
J	109	14	15S	2W	17	SE
J	109	15	15S	2W	17	SE
J	109	16	15S	2W	18	SE
J	110	1	15S	3W	11	NE
J	110	2	15S	3W	11	NE
J	110	3	15S	3W	12	NW
J	110	4	15S	3W	12	NW
J	110	5	15S	3W	12	NW
J	110	6	15S	3W	12	NW
J	114	1	15S	2W	20	NE
J	114	8	15S	2W	20	NE
J	114	11	15S	2W	20	SE
M	1	1	8S	5W	9	NE
M	1	2	8S	5W	9	NE
M	1	3	8S	5W	15	SW
M	2	1	8S	5W	12	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	2	2	8S	5W	13	NW
M	2	3	8S	5W	13	NW
M	4	1	8S	4W	4	NE
M	4	2	8S	4W	4	NE
M	4	4	8S	4W	4	NE
M	4	5	8S	4W	4	NE
M	4	6	8S	4W	4	NE
M	4	7	8S	4W	4	NE
M	4	8	8S	4W	4	SE
M	4	9	8S	4W	4	NE
M	4	10	8S	4W	4	NE
M	4	11	8S	4W	4	NE
M	4	12	8S	4W	4	NE
M	4	13	8S	4W	4	NW
M	4	19	8S	4W	4	NE
M	5	1	8S	4W	9	NE
M	5	2	8S	4W	10	NE
M	5	3	8S	4W	10	NE
M	5	4	8S	4W	10	NE
M	5	5	8S	4W	11	NW
M	5	6	8S	4W	11	NW
M	5	7	8S	4W	11	NW
M	5	8	8S	4W	11	SW
M	5	9	8S	4W	11	SW
M	7	1	8S	4W	14	SE
M	7	2	8S	4W	14	SE
M	7	4	8S	4W	14	SE
M	7	5	8S	4W	14	SW
M	7	7	8S	4W	23	NW
M	7	11	8S	4W	23	NW
M	7	14	8S	4W	23	NE
M	7	19	8S	4W	14	SE
M	7	20	8S	4W	14	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	7	21	8S	4W	14	SE
M	7	23	8S	4W	24	NE
M	7	24	8S	4W	13	SE
M	7	26	8S	4W	26	NE
M	7	27	8S	4W	14	NW
M	7	28	8S	4W	14	NW
M	7	29	8S	4W	14	NW
M	7	30	8S	4W	14	NW
M	7	37	8S	4W	12	SE
M	7	47	8S	3W	18	NW
M	7	48	8S	3W	18	NW
M	7	49	8S	3W	18	SW
M	7	50	8S	3W	18	SW
M	7	52	8S	3W	18	SW
M	7	54	8S	3W	7	SW
M	7	55	8S	3W	18	NW
M	7	57	8S	3W	7	SW
M	7	59	8S	3W	7	SW
M	8	1	8S	4W	21	SW
M	8	2	8S	4W	28	NW
M	8	3	8S	4W	28	NW
M	8	4	8S	4W	28	SW
M	8	5	8S	4W	28	NE
M	8	6	8S	4W	27	SW
M	8	7	8S	4W	27	SW
M	8	8	8S	4W	28	NW
M	8	9	8S	4W	21	SE
M	8	10	8S	4W	21	SE
M	8	12	8S	4W	28	NE
M	8	13	8S	4W	27	NW
M	8	14	8S	4W	27	SE
M	9	1	8S	4W	26	NE
M	9	2	8S	4W	26	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	9	3	8S	4W	26	NE
M	9	4	8S	4W	26	SE
M	9	5	8S	4W	26	SE
M	9	6	8S	4W	26	SE
M	9	7	8S	4W	26	SE
M	9	8	8S	4W	35	NE
M	9	9	8S	4W	25	SW
M	9	10	8S	4W	25	SW
M	9	11	8S	4W	25	SW
M	9	12	8S	4W	36	NW
M	9	13	8S	4W	36	NW
M	9	14	8S	4W	36	NE
M	9	15	8S	4W	24	SW
M	9	16	8S	4W	24	SW
M	9	17	8S	4W	24	SW
M	9	18	8S	4W	24	SW
M	9	19	8S	4W	25	NE
M	9	20	8S	4W	25	NE
M	9	21	8S	4W	25	SE
M	9	22	8S	4W	36	NE
M	9	23	8S	4W	36	NE
M	9	24	8S	3W	31	SW
M	9	25	8S	4W	24	SW
M	9	26	8S	4W	24	SW
M	9	27	8S	4W	35	NW
M	10	1	8S	3W	31	NW
M	10	2	8S	3W	31	NW
M	10	3	8S	3W	31	NW
M	10	4	8S	3W	31	NE
M	10	5	8S	3W	31	NE
M	10	6	8S	3W	31	SE
M	10	7	8S	3W	31	NE
M	10	8	8S	3W	31	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
M	10	9	8S	3W	31	SE
M	10	10	8S	3W	31	SE
M	10	11	8S	3W	32	SW
M	10	12	8S	3W	31	SE
M	11	1	9S	3W	5	NW
M	11	2	9S	3W	5	NW
M	11	3	9S	3W	6	NE
M	12	1	9S	3W	17	SW
M	12	2	9S	3W	20	NW
M	15	1	9S	3W	33	NE
M	15	2	9S	3W	33	NE
M	17	1	10S	3W	3	SE
M	18	2	10S	3W	17	NE
M	18	3	10S	3W	17	NE
M	19	1	10S	3W	9	SE
M	19	2	10S	3W	10	NW
M	19	3	10S	3W	10	NW
M	19	4	10S	3W	10	NE
M	19	5	10S	3W	10	NE
M	19	6	10S	3W	16	NE
M	20	1	10S	3W	21	SW
M	20	2	10S	3W	21	NW
M	23	1	10S	3W	29	NE
M	23	2	10S	3W	29	NE
M	24	1	9S	3W	14	SE
M	24	5	9S	3W	23	SW
M	24	7	9S	3W	26	NE
M	24	8	9S	3W	26	NE
M	26	1	9S	3W	35	SW
M	26	2	9S	3W	35	SW
M	26	3	9S	3W	35	NE
M	26	4	9S	3W	35	SE
M	26	7	9S	3W	35	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
M	26	8	9S	3W	36	NW
M	26	9	9S	3W	36	NE
M	26	12	9S	3W	25	SE
M	26	13	9S	3W	25	SE
M	26	14	9S	3W	25	SE
M	27	1	9S	2W	29	SW
M	27	2	9S	2W	30	NE
M	27	3	9S	2W	29	NW
M	27	4	9S	2W	29	NW
M	27	5	9S	2W	29	NW
M	27	6	9S	2W	20	SW
M	27	7	9S	2W	20	NW
M	28	2	10S	2W	8	SE
M	28	3	10S	2W	8	SE
M	28	4	10S	2W	9	NW
M	28	10	10S	2W	17	NW
M	28	11	10S	2W	17	NW
M	28	12	10S	2W	8	SW
M	28	13	10S	2W	8	SW
M	29	1	10S	2W	6	NE
M	29	2	10S	2W	6	NE
M	29	3	10S	2W	6	NE
M	29	4	10S	2W	6	NE
M	29	5	10S	2W	6	NE
M	29	6	10S	2W	6	NW
M	29	7	10S	2W	6	NW
M	29	8	10S	2W	6	NW
M	29	9	10S	2W	6	SE
M	29	10	10S	2W	6	SE
M	29	11	10S	2W	6	NW
M	29	12	10S	2W	6	SW
M	29	13	10S	2W	6	SW
M	29	14	10S	2W	6	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	29	15	10S	2W	6	SW
M	29	17	10S	2W	6	SW
M	29	18	10S	2W	7	NE
M	29	19	10S	2W	7	NW
M	29	20	10S	2W	7	NW
M	29	21	10S	3W	12	NE
M	29	22	10S	2W	7	SW
M	29	23	10S	2W	7	SE
M	29	24	10S	2W	7	NE
M	29	25	10S	2W	7	NE
M	29	26	10S	2W	7	SE
M	29	27	10S	2W	6	SW
M	29	29	10S	2W	6	SW
M	30	1	10S	3W	11	NE
M	30	2	10S	3W	11	NE
M	30	3	10S	3W	11	NE
M	31	1	10S	3W	14	NE
M	31	2	10S	3W	14	NE
M	31	3	10S	3W	14	NE
M	31	4	10S	3W	14	NE
M	31	5	10S	3W	14	NE
M	31	6	10S	3W	13	NW
M	31	7	10S	3W	11	SE
M	32	1	10S	3W	13	NE
M	32	2	10S	3W	13	NW
M	32	3	10S	3W	13	NW
M	32	4	10S	3W	13	NE
M	32	5	10S	3W	13	SW
M	32	6	10S	3W	13	SW
M	32	7	10S	3W	13	SW
M	32	8	10S	3W	13	NE
M	32	9	10S	2W	18	NW
M	32	10	10S	2W	18	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	32	11	10S	2W	18	NW
M	32	12	10S	2W	18	SW
M	32	13	10S	2W	19	NW
M	32	14	10S	2W	19	NW
M	32	15	10S	2W	19	NW
M	32	16	10S	2W	19	NW
M	33	1	10S	2W	18	NE
M	33	2	10S	2W	18	NE
M	33	3	10S	2W	17	NW
M	33	4	10S	2W	17	SW
M	33	6	10S	2W	9	SW
M	33	7	10S	2W	9	SW
M	33	8	10S	2W	16	NW
M	33	10	10S	2W	21	NW
M	33	11	10S	2W	21	NW
M	33	12	10S	2W	16	NE
M	34	1	10S	2W	9	SE
M	34	2	10S	2W	9	SE
M	34	3	10S	2W	9	SW
M	34	4	10S	2W	9	SE
M	34	5	10S	2W	16	NE
M	35	1	10S	2W	21	NW
M	35	2	10S	2W	16	SE
M	35	3	10S	2W	16	SE
M	35	4	10S	2W	16	NE
M	36	1	10S	2W	10	SE
M	36	2	10S	2W	11	SW
M	38	1	10S	2W	26	NW
M	38	2	10S	2W	27	NE
M	38	3	10S	2W	26	NW
M	38	4	10S	2W	26	NW
M	38	5	10S	2W	26	NW
M	38	6	10S	2W	26	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
M	38	7	10S	2W	26	NW
M	38	8	10S	2W	25	SE
M	38	9	10S	2W	25	SE
M	38	10	10S	2W	24	SE
M	38	11	10S	2W	24	SE
M	38	12	10S	2W	24	NE
M	39	1	10S	2W	20	SW
M	39	2	10S	2W	20	SW
M	39	3	10S	2W	20	SE
M	40	1	10S	2W	19	SW
M	40	2	10S	2W	19	SW
M	41	1	10S	3W	24	SE
M	41	2	10S	2W	19	NW
M	41	3	10S	2W	19	NW
M	41	4	10S	3W	24	NW
M	41	5	10S	3W	23	NE
M	41	6	10S	3W	24	NW
M	41	7	10S	3W	24	NW
M	42	1	10S	3W	14	SW
M	42	2	10S	3W	23	NW
M	43	1	11S	2W	6	NW
M	43	2	11S	2W	6	NW
M	43	5	10S	3W	36	SE
M	43	7	10S	3W	36	SW
M	43	8	10S	3W	36	SW
M	44	1	10S	3W	35	SW
M	44	2	10S	3W	27	SW
M	46	1	11S	3W	1	SW
M	46	2	11S	3W	2	SE
M	46	3	11S	3W	2	SE
M	46	4	11S	3W	3	SE
M	46	5	11S	3W	3	SE
M	46	6	11S	3W	3	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	46	7	11S	3W	3	NE
M	46	8	11S	3W	3	SE
M	46	9	11S	3W	12	NW
M	46	10	11S	3W	12	NW
M	46	11	11S	3W	12	NW
M	46	12	11S	3W	12	NW
M	46	13	11S	3W	12	SW
M	46	14	11S	3W	12	SW
M	46	15	11S	3W	12	NW
M	46	16	11S	3W	12	SW
M	46	17	11S	3W	11	SE
M	46	18	11S	3W	11	SE
M	46	19	11S	3W	1	NE
M	46	20	11S	3W	1	NE
M	46	21	11S	2W	6	NW
M	46	22	11S	2W	6	NW
M	46	23	11S	3W	1	NE
M	46	24	11S	3W	1	NE
M	47	1	11S	2W	6	SE
M	47	2	11S	2W	7	NE
M	47	3	11S	2W	7	NE
M	47	4	11S	2W	8	SW
M	47	5	11S	2W	8	SW
M	47	6	11S	2W	7	SE
M	47	7	11S	2W	7	SE
M	47	8	11S	3W	12	NE
M	47	9	11S	3W	12	SW
M	47	10	11S	3W	12	SW
M	47	11	11S	3W	12	SW
M	47	12	11S	3W	12	SW
M	47	13	11S	3W	12	SW
M	49	1	10S	2W	27	NE
M	49	2	10S	2W	27	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	49	3	10S	2W	27	SE
M	49	4	10S	2W	26	SW
M	49	5	10S	2W	35	NW
M	49	6	10S	2W	35	NW
M	49	7	10S	2W	35	NW
M	49	8	10S	2W	35	NE
M	49	9	10S	2W	35	SW
M	49	10	10S	2W	35	SW
M	49	11	10S	2W	35	SW
M	49	12	10S	2W	34	NE
M	50	1	10S	2W	35	SE
M	50	2	10S	2W	35	SE
M	50	3	10S	2W	35	SE
M	50	4	10S	2W	36	SW
M	50	5	10S	2W	36	SW
M	50	6	10S	2W	36	NW
M	50	7	10S	2W	36	SW
M	50	8	10S	2W	36	SW
M	50	9	10S	2W	25	SW
M	50	10	10S	2W	25	SW
M	50	11	10S	2W	25	NW
M	50	12	10S	2W	25	NW
M	51	1	11S	3W	10	SE
M	51	2	11S	3W	10	SE
M	51	3	11S	3W	10	SE
M	52	1	10S	2W	2	NE
M	52	2	10S	2W	2	NE
M	52	3	10S	2W	2	NE
M	52	4	10S	2W	2	NE
M	53	1	10S	1W	31	SW
M	53	2	10S	1W	31	SW
M	53	3	10S	1W	31	NW
M	53	4	10S	1W	31	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	53	5	10S	1W	31	NW
M	53	6	10S	1W	31	NW
M	53	8	10S	1W	31	NE
M	61	1	11S	1E	8	SW
M	61	2	11S	1E	8	SW
M	61	3	11S	1E	8	SW
M	61	4	11S	1E	8	SW
M	61	5	11S	1E	8	SW
M	61	6	11S	1E	8	SW
M	61	7	11S	1E	8	SW
M	61	8	11S	1E	22	NW
M	61	9	11S	1E	22	SW
M	61	10	11S	1E	22	SW
M	61	11	11S	1E	22	SW
M	61	12	11S	1E	22	SW
M	63	1	11S	1E	22	SE
M	63	2	11S	1E	22	SE
M	63	3	11S	1E	22	SE
M	63	4	11S	1E	22	SE
M	63	5	11S	1E	23	NW
M	63	6	11S	1E	23	SE
M	63	7	11S	1E	26	NW
M	63	8	11S	1E	26	NE
M	64	1	11S	1E	3	SW
M	64	2	11S	1E	3	SW
M	64	3	11S	1E	10	NW
M	64	4	11S	1E	3	SW
M	64	5	11S	1E	3	SW
M	64	6	11S	1E	3	SW
M	64	7	11S	1E	3	SE
M	64	8	11S	1E	3	NE
M	64	9	11S	1E	3	NE
M	64	10	11S	1E	2	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	64	11	11S	1E	2	SW
M	64	12	11S	1E	2	SW
M	64	13	11S	1E	2	SW
M	64	14	11S	1E	2	SW
M	64	15	11S	1E	2	SW
M	64	16	11S	1E	2	NW
M	64	17	11S	1E	2	SW
M	64	18	11S	1E	2	NW
M	64	19	11S	1E	2	NE
M	64	20	11S	1E	1	NW
M	64	21	11S	1E	1	NW
M	64	22	11S	1E	9	SE
M	68	1	11S	2E	19	NE
M	68	2	11S	2E	19	SE
M	68	3	11S	2E	19	SE
M	68	4	11S	2E	19	SW
M	68	5	11S	2E	19	SW
M	68	6	11S	2E	19	SE
M	68	7	11S	2E	19	SE
M	68	8	11S	2E	19	SE
M	68	9	11S	2E	19	SE
M	68	10	11S	2E	30	NE
M	68	11	11S	2E	29	NW
M	68	12	11S	2E	29	NW
M	68	13	11S	2E	29	NW
M	68	14	11S	2E	29	NW
M	68	15	11S	2E	29	NE
M	68	16	11S	2E	29	NE
M	68	17	11S	2E	30	NE
M	68	18	11S	2E	30	NE
M	68	19	11S	2E	30	NE
M	68	20	11S	2E	30	NE
M	68	21	11S	2E	30	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
M	68	22	11S	2E	29	SW
M	68	23	11S	2E	30	SE
M	68	24	11S	2E	30	SE
M	68	25	11S	2E	30	SE
M	68	26	11S	2E	31	NE
M	68	27	11S	2E	31	NE
M	68	28	11S	2E	31	SE
M	68	29	11S	2E	31	SE
M	68	30	11S	2E	31	SE
M	68	31	11S	2E	31	NE
M	68	33	11S	2E	28	NW
E	1	1	9S	8E	33	SE
E	1	2	9S	8E	33	SE
E	1	3	9S	8E	33	SE
E	1	4	9S	8E	33	NE
E	1	5	9S	8E	34	NW
E	1	6	9S	8E	27	SW
E	1	7	9S	8E	27	SE
E	1	8	9S	8E	34	NE
E	2	1	9S	8E	33	NW
E	2	2	9S	8E	32	SW
E	2	3	9S	8E	32	NW
E	2	4	9S	8E	32	NW
E	2	5	9S	8E	32	NW
E	2	7	9S	8E	32	NE
E	2	8	9S	8E	32	NE
E	2	9	9S	8E	32	NE
E	2	10	9S	8E	32	SE
E	2	11	9S	8E	33	SW
E	2	12	9S	8E	33	SW
E	2	13	9S	8E	33	SW
E	3	1	9S	7E	35	SW
E	3	2	9S	7E	35	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
E	3	3	9S	7E	35	SE
E	3	4	9S	7E	35	NW
E	4	1	10S	7E	22	NW
E	4	2	10S	7E	22	NW
E	4	3	10S	7E	22	NE
E	4	4	10S	7E	22	NE
E	5	1	10S	7E	10	NW
E	5	2	10S	7E	10	NW
E	5	3	10S	7E	10	NW
E	5	4	10S	7E	10	NW
E	5	5	10S	7E	10	NE
E	5	6	10S	7E	10	NE
E	7	1	10S	8E	32	SW
E	7	2	10S	8E	32	SW
E	7	3	10S	8E	32	SW
E	7	4	10S	8E	32	NW
E	7	5	10S	8E	32	NW
E	7	6	10S	8E	31	SW
E	7	7	10S	8E	31	SW
E	7	8	10S	8E	31	SW
E	7	9	10S	8E	31	SW
E	7	10	10S	8E	29	SW
E	7	11	10S	8E	29	SW
E	7	12	10S	8E	30	NE
E	10	1	10S	7E	28	NW
E	11	1	10S	7E	34	SW
E	12	1	10S	7E	20	NE
E	13	1	11S	7E	8	SE
E	13	2	11S	7E	8	SE
E	13	3	11S	7E	8	NE
E	13	4	11S	7E	5	SW
E	13	5	11S	7E	7	NE
E	13	6	11S	7E	6	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	16	1	11S	8E	5	NE
E	16	2	11S	8E	5	NE
E	16	3	11S	8E	5	NW
E	16	4	11S	8E	6	NE
E	17	1	10S	8E	33	SE
E	17	2	10S	8E	33	SE
E	17	4	10S	8E	33	NW
E	18	1	10S	8E	34	SE
E	18	2	10S	8E	34	SE
E	18	3	10S	8E	35	SW
E	18	4	10S	8E	35	SW
E	18	5	10S	8E	35	NW
E	19	1	10S	8E	25	SW
E	19	2	10S	8E	25	SW
E	19	3	10S	8E	25	NW
E	19	4	10S	8E	25	NW
E	19	5	10S	8E	26	NE
E	20	1	10S	8E	36	NE
E	20	2	10S	9E	31	SW
E	20	3	10S	9E	31	SW
E	20	4	10S	9E	32	SW
E	20	5	10S	9E	32	SW
E	20	6	10S	9E	32	NE
E	20	7	10S	9E	32	SE
E	20	8	10S	9E	32	NE
E	20	9	10S	9E	32	NE
E	20	10	10S	9E	31	SE
E	20	11	10S	9E	31	SE
E	20	12	10S	9E	31	SE
E	22	1	11S	9E	4	NE
E	22	2	11S	9E	4	NW
E	22	3	11S	9E	4	NW
E	22	4	11S	9E	4	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	22	5	11S	9E	4	NW
E	22	6	11S	9E	4	SE
E	22	7	11S	9E	4	SE
E	22	8	11S	9E	4	SE
E	26	1	11S	9E	28	NW
E	26	2	11S	9E	28	NW
E	26	3	11S	9E	28	NW
E	26	4	11S	9E	28	NE
E	26	5	11S	9E	28	NE
E	26	6	11S	9E	21	SE
E	26	7	11S	9E	28	NE
E	26	8	11S	9E	27	SW
E	26	9	11S	9E	27	SE
E	26	10	11S	9E	27	SE
E	26	11	11S	9E	21	NE
E	28	1	11S	9E	7	SW
E	28	2	11S	9E	7	SE
E	28	3	11S	9E	19	NE
E	28	4	11S	9E	19	NW
E	28	5	11S	9E	18	SE
E	28	6	11S	9E	18	SW
E	28	7	11S	9E	18	SE
E	28	8	11S	9E	19	NE
E	28	9	11S	9E	8	NW
E	28	10	11S	9E	8	SW
E	28	11	11S	9E	7	SE
E	28	12	11S	9E	8	NW
E	28	13	11S	9E	7	SE
E	28	14	11S	9E	19	NE
E	28	15	11S	9E	18	SW
E	28	18	11S	9E	19	NW
E	29	1	11S	9E	5	SW
E	29	2	11S	9E	5	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	29	3	11S	9E	5	SE
E	29	4	11S	9E	5	SW
E	29	5	11S	9E	5	NW
E	29	6	11S	9E	5	SW
E	29	7	11S	9E	5	NE
E	29	8	11S	9E	5	NE
E	29	9	11S	9E	5	SE
E	29	10	11S	9E	7	SW
E	29	11	11S	9E	7	SE
E	29	12	11S	9E	7	SE
E	29	13	11S	9E	7	SW
E	29	14	11S	9E	7	SE
E	29	15	11S	9E	7	NE
E	29	16	11S	9E	7	NE
E	29	17	11S	9E	8	NW
E	29	18	11S	9E	8	NW
E	29	19	11S	9E	8	NW
E	30	1	11S	8E	12	NE
E	30	2	11S	8E	12	NE
E	30	3	11S	8E	12	NE
E	30	4	11S	8E	1	SE
E	30	5	11S	8E	12	NE
E	30	6	11S	8E	12	NW
E	30	7	11S	8E	1	SW
E	30	8	11S	9E	7	NW
E	30	9	11S	9E	6	SW
E	30	10	11S	9E	7	NW
E	30	11	11S	9E	6	SW
E	30	12	11S	9E	6	SW
E	30	13	11S	9E	6	SE
E	30	14	11S	8E	1	SE
E	30	15	11S	8E	1	SE
E	30	16	11S	8E	1	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	30	17	11S	9E	6	NW
E	30	18	11S	9E	6	NE
E	30	19	11S	9E	6	NE
E	30	20	11S	9E	5	NW
E	30	21	11S	9E	6	NE
E	30	22	11S	9E	6	NE
E	31	1	11S	8E	24	SW
E	31	2	11S	8E	24	NW
E	31	3	11S	8E	13	SE
E	31	4	11S	8E	13	SE
E	31	5	11S	8E	13	SE
E	31	6	11S	8E	24	NE
E	31	7	11S	8E	13	SE
E	31	8	11S	9E	18	SW
E	31	9	11S	9E	18	SW
E	31	10	11S	8E	24	NW
E	31	11	11S	8E	24	SW
E	31	12	11S	9E	7	SW
E	31	13	11S	8E	24	SW
E	31	14	11S	8E	24	SW
E	31	15	11S	8E	13	SW
E	31	16	11S	9E	18	NW
E	31	17	11S	8E	13	NE
E	31	18	11S	8E	13	NE
E	31	20	11S	8E	24	NE
E	31	21	11S	8E	24	NE
E	31	23	11S	9E	19	NW
E	31	24	11S	9E	19	SW
E	31	25	11S	9E	19	SW
E	31	26	11S	8E	24	SE
E	32	1	11S	8E	14	NW
E	32	2	11S	8E	14	NW
E	32	3	11S	8E	14	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	32	4	11S	8E	15	SE
E	32	5	11S	8E	22	NE
E	32	6	11S	8E	23	SE
E	33	1	11S	8E	4	SW
E	33	2	11S	8E	4	SE
E	33	3	11S	8E	9	NE
E	33	4	11S	8E	10	NW
E	33	5	11S	8E	3	NE
E	33	6	11S	8E	2	NW
E	33	7	11S	8E	3	NW
E	33	8	11S	8E	3	NW
E	33	9	11S	8E	3	NW
E	33	10	11S	8E	4	NW
E	33	11	11S	8E	3	SW
E	36	1	11S	7E	16	SW
E	36	2	11S	7E	16	SW
E	36	3	11S	7E	16	SW
E	36	4	11S	7E	16	SE
E	36	5	11S	7E	16	SE
E	36	6	11S	7E	16	SE
E	38	1	11S	7E	29	SE
E	38	3	11S	7E	28	NW
E	38	5	11S	7E	29	NE
E	38	8	11S	7E	29	NW
E	38	9	11S	7E	29	SW
E	38	11	11S	7E	21	SW
E	38	14	11S	7E	20	SE
E	38	18	11S	7E	21	NW
E	38	19	11S	7E	20	SE
E	38	20	11S	7E	21	NW
E	38	21	11S	7E	20	NE
E	38	22	11S	7E	21	NW
E	38	23	11S	7E	28	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
E	40	1	11S	8E	31	SW
E	40	2	12S	8E	6	NE
E	40	3	12S	8E	6	NE
E	41	1	12S	7E	3	SW
E	41	2	12S	7E	4	SE
E	41	3	12S	7E	4	SE
E	41	4	12S	7E	4	SE
E	41	5	12S	7E	4	SE
E	41	6	12S	7E	4	SE
E	41	7	11S	7E	34	SW
E	41	8	12S	7E	3	NE
E	41	9	11S	7E	34	SE
E	41	10	12S	7E	3	NE
E	41	11	12S	7E	3	NE
E	41	12	11S	7E	34	SE
E	41	13	12S	7E	3	SW
E	42	1	12S	7E	8	NE
E	42	2	12S	7E	8	NE
E	42	3	12S	7E	5	SE
E	42	4	12S	7E	5	SE
E	42	5	12S	7E	4	NW
E	42	6	12S	7E	5	NE
E	42	7	12S	7E	5	NE
E	42	8	12S	7E	4	NW
E	42	9	11S	7E	33	SW
E	42	10	11S	7E	33	SW
E	42	12	11S	7E	33	SE
E	42	13	11S	7E	33	NE
E	42	14	11S	7E	33	NE
E	42	15	11S	7E	33	NE
E	42	16	11S	7E	28	SE
E	42	17	11S	7E	28	SE
E	42	18	11S	7E	28	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	42	19	11S	7E	33	NW
E	42	20	12S	7E	4	NW
E	42	21	12S	7E	4	NW
E	42	22	12S	7E	4	NW
E	42	23	12S	7E	9	NW
E	42	24	12S	7E	4	SW
E	42	25	12S	7E	9	NW
E	43	1	12S	7E	6	NE
E	43	2	11S	7E	31	SW
E	43	3	11S	7E	31	SW
E	43	4	11S	7E	31	SE
E	43	5	11S	7E	31	SE
E	43	6	11S	7E	32	SW
E	43	7	11S	7E	32	SW
E	43	8	11S	7E	31	NE
E	43	9	11S	7E	32	NW
E	43	10	11S	7E	32	NW
E	43	11	11S	7E	32	NE
E	43	13	11S	7E	32	SE
E	43	14	11S	7E	32	SE
E	43	15	11S	7E	32	SE
E	43	21	11S	7E	31	NW
E	43	22	11S	7E	31	SW
E	43	24	12S	7E	6	NE
E	43	30	12S	7E	6	SE
E	43	31	12S	7E	7	NE
E	43	32	12S	7E	7	NW
E	43	33	12S	7E	6	NW
E	43	34	12S	7E	6	SE
E	43	35	12S	7E	6	NE
E	43	36	12S	7E	5	NW
E	43	37	12S	7E	5	SW
E	44	1	12S	7E	18	SE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
E	44	2	12S	7E	18	SE
E	44	3	12S	7E	18	SW
E	44	4	12S	7E	19	NW
E	44	5	12S	7E	18	SW
E	44	6	12S	7E	18	NE
E	44	7	12S	7E	18	NE
E	44	8	12S	7E	18	SE
E	44	10	12S	7E	17	SW
E	44	11	12S	7E	17	NE
E	44	12	12S	7E	17	NE
E	44	13	12S	7E	17	NE
E	44	14	12S	7E	17	NE
E	44	16	12S	7E	8	SW
E	44	17	12S	7E	17	NW
E	44	18	12S	7E	8	SW
E	44	19	12S	7E	8	SW
E	44	20	12S	7E	8	NE
E	44	25	12S	7E	8	NE
E	44	27	12S	7E	17	NW
E	44	28	12S	7E	19	SW
E	44	29	12S	7E	19	SW
E	46	1	12S	7E	29	SW
E	47	1	12S	7E	34	NE
E	47	2	12S	7E	22	SW
E	47	4	12S	7E	27	NE
E	47	5	12S	7E	27	NW
E	47	6	12S	7E	27	NW
E	48	1	12S	7E	21	NW
E	48	2	12S	7E	21	SW
E	48	3	12S	7E	21	NE
E	48	5	12S	7E	16	SE
E	48	6	12S	7E	17	SE
E	52	1	12S	8E	15	NW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
E	52	2	12S	8E	15	NW
E	52	3	12S	8E	10	SW
E	52	4	12S	8E	16	NW
E	52	5	12S	8E	16	NW
E	52	6	12S	8E	15	SW
E	52	7	12S	8E	10	SW
E	52	8	12S	8E	10	SW
E	52	9	12S	8E	9	SE
E	52	10	12S	8E	9	SE
E	52	11	12S	8E	15	SE
E	52	12	12S	8E	15	SE
E	52	13	12S	8E	15	SW
E	52	14	12S	8E	16	NE
E	52	15	12S	8E	16	SE
E	52	16	12S	8E	16	NW
E	52	17	12S	8E	9	SE
E	52	18	12S	8E	10	SE
E	52	19	12S	8E	10	SE
E	52	20	12S	8E	10	SE
E	52	21	12S	8E	10	SE
E	52	22	12S	8E	10	SE
E	52	23	12S	8E	15	SW
E	52	25	12S	8E	3	SE
E	53	1	12S	8E	1	SW
E	53	2	12S	8E	12	NW
E	53	3	12S	8E	12	NW
E	53	4	12S	8E	12	NE
E	56	1	12S	9E	6	SE
E	56	2	12S	9E	6	SW
E	57	1	11S	9E	28	NW
E	57	2	11S	9E	28	SW
E	57	3	11S	9E	27	SE
E	57	4	11S	9E	27	SW

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{2}$ Section
E	58	1	11S	9E	27	NE
E	60	1	11S	10E	17	SW
E	60	3	11S	10E	20	SW
E	60	4	11S	10E	20	SE
E	60	5	11S	10E	20	SE
E	60	6	11S	10E	20	SE
E	61	1	11S	10E	28	NE
E	61	2	11S	10E	28	SE
E	61	3	11S	10E	28	NW
E	61	4	11S	10E	28	SW
E	62	1	11S	10E	28	SE
E	62	2	11S	10E	34	NW
E	63	1	12S	10E	5	NW
E	63	2	11S	10E	32	SE
E	63	3	12S	10E	5	NE
E	63	4	12S	10E	5	NE
E	63	5	11S	10E	32	SE
E	67	1	12S	10E	4	SW
E	67	2	12S	10E	3	SW
E	67	3	11S	10E	33	SE
E	67	4	11S	10E	33	SW
E	67	5	12S	10E	9	NE
E	69	1	11S	8E	27	NE
E	69	2	11S	8E	27	NW
E	69	3	11S	8E	27	NW
E	69	4	11S	8E	21	SE
E	69	5	11S	8E	28	NW
E	69	6	11S	8E	21	SW
E	69	7	11S	8E	21	NE
E	69	8	11S	8E	27	NW
E	69	9	11S	8E	22	NW
E	69	10	11S	8E	22	NW
E	69	11	11S	8E	21	NE

Appendix A. Continued.

Dist	Comp	Open	Township	Range	Section	$\frac{1}{4}$ Section
E	69	12	11S	8E	21	NE
E	69	13	11S	8E	21	NE
E	69	14	11S	8E	21	SE
E	69	15	11S	8E	21	SE
E	69	16	11S	8E	22	NE
E	69	17	11S	8E	27	NW
E	69	19	12S	8E	3	NE
E	69	20	12S	8E	3	NE
E	69	22	11S	8E	21	SW
E	72	1	12S	9E	17	NW
E	72	2	12S	9E	17	NW
E	72	4	12S	9E	17	NE
E	72	5	12S	9E	17	SE
E	72	6	12S	9E	17	SE
E	72	7	12S	9E	17	SE
E	72	8	12S	9E	17	NW
E	72	9	12S	9E	17	SE
E	72	10	12S	8E	14	NW
E	72	11	12S	8E	14	NE
E	72	12	12S	8E	14	NE
E	72	13	12S	8E	14	NE

Appendix B1. Percent frequency of openings by surrounding dominant forest type for natural divisions of the Shawnee National Forest.

Natural division	N	Surrounding forest type								
		Oak hickory	Southern pine	Cove hardwoods	Open/brushy	White Pine	Bottomland hardwoods	Blackjack/post oak	Pin Oak	Black Locust
Cretaceous Hills	82	51.2	35.4	7.3	2.4	0.0	0.0	2.4	0.0	1.2
Greater Shawnee Hills	835	48.1	32.9	5.7	4.1	2.8	3.1	3.1	0.0	0.1
Lesser Shawnee Hills	307	49.3	25.5	7.1	4.7	8.7	1.7	3.0	0.0	0.0
Mississippi River Bottomlands	22	4.5	0.0	0.0	0.0	0.0	50.0	0.0	54.5	0.0
Ozark Hills	229	77.7	4.4	15.3	2.2	0.0	0.0	0.0	0.0	0.4
Southern Till Plain	61	62.3	3.3	23.0	3.3	6.6	1.6	0.0	0.0	0.0
TOTAL	1536	52.7	25.7	8.3	3.8	3.5	2.7	2.4	0.8	0.2

Appendix B2. Percent frequency of openings by vegetation type for natural divisions of the Shawnee National Forest.

Vegetation Type	Natural divisions						Total
	CPC ¹	GSH ²	LSH ³	MRB ⁴	OHS ⁵	STP ⁶	
N=	26	216	77	14	89	37	459
Little bluestem	7.7	3.2	15.6	0.0	0.0	0.0	4.6
Forb, little bluestem	11.5	2.8	10.4	0.0	2.3	0.0	4.1
Indian grass, big and little bluestem	7.7	0.0	5.2	0.0	0.0	2.7	1.5
Broom sedge	0.0	0.5	1.3	0.0	1.1	0.0	0.7
Ragweed, wild carrot, lespedza	34.6	3.7	5.2	0.0	5.6	0.0	5.7
Beggar-ticks	0.0	0.9	2.6	0.0	0.0	0.0	0.9
Tame legume	0.0	8.8	3.9	0.0	10.1	0.0	6.8
Tame legume, goldenrod, wild carrot, annual brome grass, sweet clover	3.9	3.2	1.3	0.0	5.6	2.7	3.3
Orchard grass, forb	0.0	0.0	0.0	0.0	3.4	0.0	0.7
Cereal grain	0.0	5.1	0.0	0.0	0.0	0.0	2.4
Panic grass, western ragweed, beggar-ticks fleabane, goldenrod, ret top	0.0	10.7	1.3	0.0	1.1	0.0	5.5
Goldenrod	7.7	17.1	11.7	0.0	30.3	51.4	20.5
Fescue	7.7	10.2	9.1	7.1	3.4	27.0	9.8
Fescue, goldenrod	7.7	16.7	24.7	0.0	4.5	10.8	14.2
Sassafras, persimmon, sumac	0.0	3.2	1.3	0.0	20.2	2.7	5.9
Deer's tongue, sedge jewelweed	0.0	5.1	1.3	0.0	10.1	0.0	4.6
Aster, sedge, beggar-ticks moneywort, sawtooth sunflower	0.0	0.9	0.0	92.9	0.0	0.0	0.0
Cool season grasses	0.0	2.3	2.6	0.0	2.3	0.0	2.0

Appendix B2. Continued.

Vegetation Type	Natural divisions						Total
	CPC	GSH	LSH	MRB	OHS	STP	
N=	26	216	77	14	89	37	459
Purple top, bluegrass panic grass, coralberry	0.0	0.5	1.3	0.0	1.1	0.0	0.4
Smooth brome	0.0	0.5	0.0	0.0	0.0	2.7	0.4
Honeysuckle	7.7	1.4	0.0	0.0	0.0	0.0	1.1
Vetch	3.9	1.4	0.0	0.0	0.0	0.0	0.9
Sericea lespedeza	0.0	0.9	0.0	0.0	0.0	0.0	0.4
Sweet clover	0.0	0.9	1.3	0.0	0.0	0.0	0.7

¹Coastal Plain Cretaceous Hills

²Greater Shawnee Hills

³Lesser Shawnee Hills

⁴Mississippi River Bottomlands

⁵Ozark Hills

⁶Southern Till Plain

Appendix B3. Percent frequency of openings by size class for natural divisions of the Shawnee National Forest.

Natural division	N	Opening size (ha)							
		0.1	0.2	0.3 - .4	0.5 - .6	0.7 - .8	0.9 - 1.0	>1.1	
Cretaceous Hills	83	1.2	3.6	32.5	27.7	18.1	7.2	9.6	
Greater Shawnee Hills	779	4.7	11.6	35.0	21.3	11.4	6.7	9.2	
Lesser Shawnee Hills	265	1.5	8.7	38.1	23.8	15.1	4.5	8.3	
Mississippi River Bottomlands	17	29.4	41.2	5.9	11.8	5.9	0.0	5.9	
Ozark Hills	177	11.3	38.4	28.8	10.7	5.1	1.7	4.0	
Southern Till Plain	57	7.0	26.3	47.4	12.3	5.3	1.8	0.0	
TOTAL	1376	5.2	14.9	34.9	20.3	11.4	5.4	8.0	

Appendix B4. Percent frequency of openings by soil series¹ for² natural divisions of the Shawnee National Forest.

Soil series	Natural division						Total
	CPC ³	GSH ⁴	LSH ⁵	MRB ⁶	OHS ⁷	STP ⁸	
N =	82	808	300	22	245	59	1516
Alford	3.7	18.9	10.3	0.0	41.6	61.0	21.4
Banlic	0.0	2.1	0.0	0.0	0.0	0.0	1.1
Belknap	2.4	0.2	2.0	0.0	0.0	0.0	0.7
Birds	0.0	0.1	0.0	4.5	0.0	0.0	0.1
Burnside	8.5	4.0	4.0	0.0	0.0	0.0	3.4
Darwin	0.0	0.0	0.0	9.1	0.0	0.0	0.1
Elsah	0.0	0.0	1.0	9.1	18.4	0.0	3.2
Goss-Alford Complex	0.0	0.0	0.0	0.0	14.3	0.0	2.3
Grantsburg	0.0	39.6	43.7	0.0	0.0	0.0	29.7
Haymond	0.0	0.0	0.0	0.0	11.4	3.4	2.6
Hosmer	69.5	21.4	26.3	0.0	2.4	33.9	22.1
Hosmer-Lax Complex	6.1	0.0	0.7	0.0	0.0	0.0	0.5
Jacob clay	0.0	0.0	0.0	59.1	0.0	0.0	0.9
St. Charles	0.0	0.0	0.0	9.1	0.0	0.0	0.4
Stookey-Bodine Complex	0.0	0.0	0.0	0.0	8.6	0.0	1.4
Wakeland	0.0	0.0	1.0	9.1	0.0	0.0	0.6
Wellston	2.4	0.0	1.6	0.0	0.0	0.0	1.3
Zanesville	3.7	8.2	4.3	0.0	0.0	0.0	5.5

¹U.S.D.A. county soil survey manuals

²Includes soil series which account for at least 90% of openings within each natural division.

³Cretaceous Hills

⁴Greater Shawnee Hills

⁵Lesser Shawnee Hills

⁶Mississippi River Bottomlands

⁷Ozark Hills

⁸Southern Till Plain

Appendix B5. Percent frequency of openings by access type for natural divisions of the Shawnee National Forest.

Natural division	N	Type of Access				Three Wheeler	No access
		Gravel road	Dirt/Grass	Dirt/Grass tractor			
Cretaceous Hills	34	5.9	82.4	11.8	0.0	0.0	0.0
Greater Shawnee Hills	302	13.9	53.3	21.9	5.3	5.6	
Lesser Shawnee Hills	93	16.1	54.8	28.0	1.1	0.0	
Mississippi River Bottomlands	14	14.3	35.7	50.0	0.0	0.0	
Ozark Hills	100	18.0	30.0	24.0	20.0	8.0	
Southern Till Plain	53	1.9	54.7	43.4	0.0	0.0	
TOTAL	596	13.4	51.0	25.2	6.2	4.2	

Appendix B6. Percent frequency of openings by aspect category for natural divisions of the Shawnee National Forest.

Natural division	N	Aspect			
		1°-90°	91°-180°	181°-270°	271°-360°
Cretaceous Hills	18	11.1	27.8	38.9	22.2
Greater Shawnee Hills	209	31.1	22.0	21.5	25.4
Lesser Shawnee Hills	64	18.8	26.6	29.7	25.0
Mississippi River Bottomlands	0	0.0	0.0	0.0	0.0
Ozark Hills	70	34.3	24.3	15.7	25.7
Southern Till Plain	33	33.3	30.3	9.1	27.3
TOTAL	394	28.9	24.1	21.6	25.4

Appendix B7. Percent frequency of openings by slope category for natural divisions of the Shawnee National Forest.

Natural division	N	% Slope				
		0 - 2	3 - 4	5 - 7	8 - 12	> 13
Cretaceous Hills	28	25.0	10.7	25.0	17.0	21.4
Greater Shawnee Hills	241	30.3	18.7	24.5	16.6	10.0
Lesser Shawnee Hills	77	20.8	26.0	28.6	9.1	15.6
Mississippi River Bottomlands	15	100.0	0.0	0.0	0.0	0.0
Ozark Hills	85	42.4	16.5	21.2	8.2	11.8
Southern Till Plain	34	20.6	20.6	38.2	17.7	2.9
TOTAL	480	32.1	18.5	24.8	13.5	11.0

Appendix B8. Percent frequency of openings by amount of deciduous habitat within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	% Deciduous				
		0-20	21-40	41-60	61-80	81-100
Cretaceous Hills	82	1.2	9.8	9.8	43.9	35.4
Greater Shawnee Hills	662	1.4	6.2	24.3	41.5	26.6
Lesser Shawnee Hills	186	1.1	8.6	27.4	42.5	26.6
Mississippi River Bottomlands	17	0.0	0.0	0.0	17.6	82.4
Ozark Hills	152	0.0	0.0	0.7	15.8	83.6
Southern Till Plain	38	0.0	0.0	21.1	39.5	39.5
TOTAL	1137	1.1	5.7	20.1	38.0	35.1

Appendix B9. Percent frequency of openings by amount of coniferous habitat within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	% Coniferous				
		0-5	6-15	16-30	31-45	46-60
						> 61
Cretaceous Hills	82	9.8	31.7	34.2	15.9	8.5
Greater Shawnee Hills	662	16.9	23.4	35.2	16.8	6.2
Lesser Shawnee Hills	186	17.2	28.0	31.7	10.8	10.2
Mississippi River Bottomlands	17	100.0	0.0	0.0	0.0	0.0
Ozark Hills	152	84.0	15.1	0.0	0.0	0.0
Southern Till Plain	38	39.5	36.8	18.4	5.2	0.0
TOTAL	1137	27.5	23.7	28.8	12.8	5.9
						1.2

Appendix B10. Percent frequency of openings by amount of open habitat within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural divisions	N	% Open					
		0-3	4-5	6-10	11-15	16-25	26-50
Cretaceous Hills	82	31.7	36.6	20.7	6.1	4.9	0.0
Greater Shawnee Hills	662	38.2	21.5	27.5	7.4	4.7	0.8
Lesser Shawnee Hills	186	34.4	27.4	15.6	10.8	9.7	2.2
Mississippi River Bottomlands	17	52.9	5.9	23.5	5.9	11.8	0.0
Ozark Hills	152	57.2	7.2	9.2	14.5	6.6	5.3
Southern Till Plain	38	31.6	21.1	39.5	7.9	0.0	0.0
TOTAL	1137	39.7	21.4	23.0	8.8	5.7	1.5

Appendix B11. Percent frequency of openings by amount of cropland habitat within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural divisions	N	% Cropland				
		0-3	4-10	11-25	26-40	≥ 41
Cretaceous Hills	82	91.5	2.4	6.1	0.0	0.0
Greater Shawnee Hills	662	92.7	4.8	2.3	0.2	0.0
Lesser Shawnee Hills	186	83.3	7.5	7.5	1.1	0.5
Mississippi River Bottomlands	17	76.5	11.8	5.9	5.9	0.0
Ozark Hills	152	94.7	2.6	2.6	0.0	0.0
Southern Till Plain	38	76.3	15.8	7.9	0.0	0.0
TOTAL	1137	90.6	5.3	3.7	0.4	0.1

Appendix B12. Percent frequency of openings by amount of pasture/hayfield habitat within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	% Pasture/hayfield					
		0-3	4-10	11-20	21-30	31-45	46-60
Cretaceous Hills	82	80.5	11.0	6.1	1.2	1.2	0.0
Greater Shawnee Hill	662	72.1	13.7	8.9	3.3	1.5	0.5
Lesser Shawnee Hills	186	74.7	11.3	9.7	2.7	1.6	0.0
Mississippi River Bottomlands	17	100.0	0.0	0.0	0.0	0.0	0.0
Ozark Hills	152	86.8	7.2	4.6	1.3	0.0	0.0
Southern Till Plain	38	52.6	15.8	21.1	10.5	0.0	0.0
TOTAL	1137	74.8	12.1	8.5	3.0	1.2	0.3

Appendix B13. Percent frequency of openings by distance to cropland for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to cropland									
		0-50	51-100	101-200	201-300	301-400	401-600	601-800	>801		
Cretaceous Hills	82	4.9	0.0	4.9	7.3	8.5	13.4	14.6	46.3		
Greater Shawnee Hills	745	2.4	0.5	1.7	4.6	4.8	10.6	16.9	58.4		
Lesser Shawnee Hills	213	1.9	3.3	4.7	8.5	6.1	12.2	11.7	51.6		
Mississippi River Bottomlands	18	0.0	11.1	0.0	5.6	11.1	5.6	16.7	50.0		
Ozark Hills	175	0.6	1.1	1.1	2.3	4.0	16.6	17.1	57.1		
Southern Till Plain	61	4.9	0.0	3.3	4.9	11.5	34.4	23.0	18.0		
TOTAL	1294	2.3	1.2	2.4	5.1	5.6	12.9	16.2	54.3		

Appendix B14. Percent frequency of openings by distance to pasture/hayfield for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to cropland								
		0-50	51-100	101-200	201-300	301-400	401-600	601-800	>801	
Cretaceous Hills	83	4.8	0.0	2.4	8.4	6.0	26.5	9.6	42.1	
Greater Shawnee Hills	807	6.2	3.3	8.6	10.0	8.6	18.6	12.5	32.2	
Lesser Shawnee Hills	220	5.5	2.7	14.1	9.5	6.8	13.6	16.8	30.9	
Mississippi River Bottomlands	4	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0	
Ozark Hills	176	0.6	0.0	5.7	6.8	6.8	15.3	14.2	50.6	
Southern Till Plain	61	9.8	3.3	13.1	16.4	11.5	23.0	11.5	11.5	
TOTAL	1351	5.4	2.6	8.9	9.7	8.0	18.0	13.3	34.1	

Appendix B15. Percent frequency of openings by distance to open habitat for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to open habitat						
		0-100	101-200	201-300	301-400	401-600	601-800	>801
Cretaceous Hills	83	48.2	21.7	19.3	7.2	3.6	0.0	0.0
Greater Shawnee Hills	814	52.6	23.0	14.7	6.0	2.9	0.6	0.1
Lesser Shawnee Hills	207	52.7	28.0	11.6	5.3	1.4	1.0	0.0
Mississippi River Bottomlands	19	57.9	26.3	0.0	15.8	0.0	0.0	0.0
Ozark Hills	179	49.2	25.1	10.1	10.6	3.9	0.6	0.6
Southern Till Plain	61	62.3	24.6	9.8	1.6	1.6	0.0	0.0
TOTAL	1363	52.4	24.1	13.5	6.5	2.8	0.6	0.2

Appendix B16. Percent frequency of openings by distance to water source for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to water				
		0-50	51-100	101-200	201-300	301-400 ≥ 401
Cretaceous Hills	83	37.4	16.9	28.9	12.1	4.8 0.0
Greater Shawnee Hills	791	28.7	13.7	27.4	15.8	7.0 7.5
Lesser Shawnee Hills	213	31.0	17.8	26.8	16.9	5.2 2.3
Mississippi River Bottomlands	19	36.8	26.3	21.1	10.5	5.3 0.0
Ozark Hills	226	58.9	16.8	15.0	4.4	3.5 1.3
Southern Till Plain	61	18.0	21.3	37.7	18.0	3.3 1.6
TOTAL	1393	34.1	15.5	25.8	13.9	5.8 4.9

Appendix B17. Percent frequency of openings by distance to occupied dwelling for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to dwelling			
		0-200	201-500	501-900	>901
Cretaceous Hills	83	0.0	10.8	31.3	57.8
Greater Shawnee Hills	798	2.3	11.4	31.5	54.9
Lesser Shawnee Hills	204	3.0	15.7	27.5	53.9
Mississippi River Bottomlands	8	0.0	0.0	37.5	62.5
Ozark Hills	173	0.6	5.8	34.7	59.0
Southern Till Plain	57	3.5	22.8	38.6	35.1
TOTAL	1323	2.0	11.7	31.6	54.7

Appendix B18. Percent frequency of openings by number of occupied dwellings within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	Number of dwellings			
		0	1	2-4	≥5
Cretaceous Hills	83	91.6	6.0	2.4	0.0
Greater Shawnee Hills	816	90.3	7.6	2.0	0.1
Lesser Shawnee Hills	211	83.9	10.4	4.7	0.9
Mississippi River Bottomlands	19	94.7	5.3	0.0	0.0
Ozark Hills	180	96.1	2.2	1.1	0.6
Southern Till Plain	61	83.6	11.5	3.3	1.6
TOTAL	1370	89.9	7.4	2.3	0.4

Appendix B19. Percent frequency of openings by distance to public gravel road for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to road					
		0-100	101-400	401-800	801-1200	1200-1600	>1601
Cretaceous Hills	58	5.2	10.3	27.6	20.7	10.3	25.9
Greater Shawnee Hills	575	12.9	14.3	13.9	19.0	8.4	31.7
Lesser Shawnee Hills	153	19.6	16.3	7.8	13.7	9.8	32.7
Mississippi River Bottomlands	14	21.4	57.1	7.1	0.0	0.0	14.3
Ozark Hills	76	26.3	7.9	7.9	10.5	9.2	38.2
Southern Till Plain	53	1.9	15.1	20.8	22.6	11.3	28.3
TOTAL	929	14.1	14.5	13.6	17.4	8.8	31.5

Appendix B20. Percent frequency of openings by kilometers of gravel or paved road within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	Kilometers of road					
		0.0	0.1-0.5	0.6-1.0	1.1-1.5	1.6-2.0	>2.1
Cretaceous Hills	83	77.1	3.6	15.7	3.6	0.0	0.0
Greater Shawnee Hills	804	70.6	7.8	14.3	5.8	1.2	0.1
Lesser Shawnee Hills	206	67.5	5.3	15.0	8.3	3.9	0.0
Mississippi River Bottomlands	17	23.5	11.8	52.9	0.0	0.0	11.8
Ozark Hills	173	79.2	4.1	8.7	5.2	2.3	0.6
Southern Till Plain	61	39.3	8.2	31.2	13.1	4.9	3.3
TOTAL	1344	69.6	6.8	15.0	6.3	1.9	0.5

Appendix B21. Percent frequency of openings by number of managed openings within a 0.5-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	Number of managed openings			
		0-1	2-4	5-7	>8
Cretaceous Hills	83	30.1	56.6	12.1	1.2
Greater Shawnee Hills	816	32.8	50.9	14.6	1.7
Lesser Shawnee Hills	221	29.9	57.5	11.8	0.9
Mississippi River Bottomlands	20	80.0	15.0	5.0	0.0
Ozark Hills	182	45.6	44.0	9.3	1.1
Southern Till Plain	61	24.6	54.1	8.2	13.1
TOTAL	1383	34.2	51.0	12.9	2.0

Appendix B22. Percent frequency of openings by number of managed openings within a 1.0-km radius for natural divisions of the Shawnee National Forest.

Natural division	N	Number of managed openings			
		0-4	5-10	11-15	≥16
Cretaceous Hills	83	36.1	47.0	16.9	0.0
Greater Shawnee Hills	814	28.1	55.2	11.7	5.0
Lesser Shawnee Hills	221	27.6	52.0	15.4	5.0
Mississippi River Bottomlands	20	100.0	0.0	0.0	0.0
Ozark Hills	175	56.6	33.7	6.9	2.9
Southern Till Plain	61	18.0	60.7	19.7	1.6
TOTAL	1374	32.8	50.9	12.2	4.2

Appendix B23. Percent frequency of openings by distance to managed opening for natural divisions of the Shawnee National Forest.

Natural division	N	Distance (m) to managed opening						
		0-100	101-200	201-300	301-400	401-600	601-800	>801
Cretaceous Hills	83	37.4	18.1	26.5	10.8	4.8	2.4	0.0
Greater Shawnee Hills	814	33.5	25.7	19.2	9.2	7.5	2.3	2.6
Lesser Shawnee Hills	207	28.0	29.0	20.8	8.7	9.2	4.3	0.0
Mississippi River Bottomlands	17	5.9	23.5	11.8	23.5	17.6	5.9	11.8
Ozark Hills	179	22.4	25.7	20.7	15.1	8.4	3.4	4.5
Southern Till Plain	61	41.0	27.9	16.4	4.9	3.3	1.6	4.9
TOTAL	1361	31.5	25.8	19.8	10.0	7.6	2.8	2.5

Appendix C1. Percent frequency of openings by surrounding dominant forest type for districts of the Shawnee National Forest.

District	N	Surrounding forest type							
		Oak- hickory	Southern pine	Cove hardwoods	Open/ brushy	White pine	Bottomland hardwoods	Blackjack/ post oak	Pin oak Black locust
Elizabethtown	401	48.6	29.7	4.7	2.7	7.5	1.5	5.2	0.0
Jonesboro	199	82.4	5.0	12.1	0.0	0.0	0.0	0.0	0.5
Murphysboro	398	52.8	9.3	15.3	5.0	5.5	8.3	0.5	0.3
Vienna	<u>538</u>	<u>44.8</u>	<u>42.4</u>	<u>4.5</u>	<u>5.0</u>	<u>0.2</u>	<u>0.4</u>	<u>2.6</u>	<u>0.2</u>
Total	1536	52.7	25.7	8.3	3.8	3.5	2.7	2.4	0.8 0.2

Appendix C2. Percent frequency of openings by vegetation type for districts of the Shawnee National Forest.

Vegetation Type	Districts				Total
	Elizabethtown	Jonesboro	Murphysboro	Vienna	
N=	60	73	178	148	459
Little bluestem	18.5	0.0	0.0	6.8	4.6
Forb, little bluestem	5.0	2.7	1.1	8.1	4.1
Indian grass, big and little bluestem	6.7	0.0	0.6	1.4	1.5
Broom sedge	0.0	0.0	1.1	0.7	0.7
Ragweed, wild carrot, lespedeza	3.3	6.9	0.0	12.8	5.7
Beggar-ticks	1.7	0.0	0.0	2.0	0.9
Tame legumes	11.7	12.3	6.2	2.7	6.8
Tame legume, goldenrod, wild carrot, annual brome grasses, sweet clover	3.3	6.9	1.1	4.1	3.3
Orchard grass, forb	0.0	4.1	0.0	0.0	0.7
Cereal grain	0.0	0.0	0.0	7.4	2.4
Panic grass, western ragweed, beggar-ticks, fleabane, goldenrod, red top	1.7	1.4	9.0	4.7	5.5
Goldenrod	10.0	21.9	32.6	9.5	20.5
Fescue	18.3	4.1	11.2	7.4	9.8
Fescue, goldenrod	11.7	0.0	11.8	25.0	14.2
Sassafras, persimmon, sumac	1.7	24.7	4.5	0.0	5.9
Deer's tongue, sedge, jewelweed	1.7	12.3	5.6	0.7	4.6

Appendix C2. Continued.

Vegetation type	Districts				Total
	Elizabethtown	Jonesboro	Murphysboro	Vienna	
N=	60	73	178	148	459
Aster, sedge, beggar ticks, moneywort, sawtooth sunflower	0.0	0.0	8.4	0.0	3.3
Cool season grasses	1.7	2.7	2.8	0.7	2.0
Purple top, bluegrass Panic grass, coralberry	1.7	0.0	0.0	0.7	0.4
Smooth brome	0.0	0.0	1.1	0.0	0.4
Honeysuckle	0.0	0.0	0.6	2.7	1.1
Vetch	0.0	0.0	0.6	2.0	0.9
Sericea lespedeza	0.0	0.0	1.1	0.0	0.4
Sweet clover	1.7	0.0	0.6	0.0	0.7

Appendix C3. Percent frequency of openings by size class for districts of the Shawnee National Forest.

District	N	Opening Size (ha)							
		0.1	0.2	0.3-.4	0.5-.6	0.7-.8	0.9-1.0	>1.1	
Elizabethtown	361	1.4	6.1	31.9	25.8	17.5	7.8	9.7	
Jonesboro	147	13.6	44.2	23.1	7.5	5.4	2.0	4.1	
Murphysboro	345	9.9	22.3	42.0	15.7	5.2	1.5	3.5	
Vienna	523	2.3	7.8	35.6	23.1	13.0	7.3	10.9	
TOTAL	1376	5.2	14.9	34.9	20.3	11.4	5.4	8.0	

Appendix C4. Percent frequency of openings by soil series¹ for districts of the Shawnee National Forest.²

Soil Series	District				Total
	E ³	J ⁴	M ⁵	V ⁶	
N =	389	218	377	532	1516
Alford	13.9	43.6	45.1	1.1	21.4
Banlic	0.0	0.0	4.5	1.1	1.1
Burnside	2.6	0.0	6.3	3.4	3.4
Elsah	0.0	16.1	3.7	0.0	3.2
Goss-Alford Complex	0.0	15.6	0.3	0.0	2.3
Grantsburg	31.9	0.0	0.0	61.4	29.7
Haymond	0.0	9.6	4.8	0.0	2.6
Hosmer	37.1	1.8	23.6	18.4	22.1
Jacob clay	0.0	0.0	3.4	0.0	0.9
Stookey-Bodine Complex	0.0	9.6	0.0	0.0	1.4
Wellston	3.1	0.0	0.0	1.5	1.3
Zanesville	5.7	0.0	0.8	10.9	5.5

¹ = U.S.D.A. county soil survey manuals

² = Includes soil series which account for at least 90% of openings within each district.

³ = Elizabethtown

⁴ = Jonesboro

⁵ = Murphysboro

⁶ = Vienna

Appendix C5. Percent frequency of openings by access type for districts of the Shawnee National Forest.

District	N	Type of access			
		Gravel road	Dirt/grass	Dirt/grass tractor	Three wheeler No access
Elizabethtown	81	23.5	58.0	17.3	1.2 0.0
Jonesboro	84	21.4	34.5	10.7	23.8 9.5
Murphysboro	241	5.8	42.3	39.8	5.0 7.1
Vienna	190	15.3	66.3	16.3	2.1 0.0
	—	—	—	—	—
TOTAL	596	13.4	51.0	25.2	6.2 4.2

Appendix C6. Percent frequency of openings by aspect category for districts of the Shawnee National Forest.

District	N	Aspect			
		1°-90°	91°-180°	181°-270°	271°-360°
Elizabethtown	52	23.1	17.3	32.7	26.9
Jonesboro	61	37.7	21.3	16.4	24.6
Murphysboro	158	31.7	24.7	20.3	23.4
Vienna	123	23.6	27.6	21.1	27.6
	—	—	—	—	—
TOTAL	394	28.9	24.1	21.6	25.4

Appendix C7. Percent frequency of openings by slope category for districts of the Shawnee National Forest.

District	N	% Slope				
		0-2	3-4	5-7	8-12	≥13
Elizabethtown	58	22.4	31.0	24.1	12.1	10.3
Jonesboro	69	37.7	18.8	18.8	10.1	14.5
Murphysboro	197	37.6	15.7	25.4	14.7	6.6
Vienna	156	26.3	17.3	26.9	14.1	15.4
TOTAL	480	32.1	18.5	24.8	13.5	11.0

Appendix C8. Percent frequency of openings by amount of deciduous habitat within a 0.5-km radius for districts of the Shawnee National Forest.

District	N	% Deciduous				
		0-20	21-40	41-60	61-80	81-100
Elizabethtown	286	1.1	4.6	26.6	38.8	29.0
Jonesboro	125	0.0	0.0	0.8	12.0	87.2
Murphysboro	200	1.5	3.5	12.5	33.0	49.5
Vienna	526	1.1	8.6	24.1	45.6	20.5
TOTAL	1137	1.1	5.7	20.1	38.0	35.1

Appendix C9. Percent frequency of openings by amount of coniferous habitat within a 0.5-km radius for districts of the Shawnee National Forest.

Districts	N	% Coniferous				
		0-5	6-15	16-30	31-45	46-60
Elizabethtown	286	15.0	31.5	35.0	12.6	4.6
Jonesboro	125	84.0	16.0	0.0	0.0	0.0
Murphysboro	200	55.0	22.5	17.0	3.5	1.5
Vienna	526	10.5	21.9	36.7	19.6	9.7
TOTAL	1137	27.5	23.7	28.8	12.8	5.9

Appendix C10. Percent frequency of openings by amount of open habitat within a 0.5-km radius for districts of the Shawnee National Forest.

Districts	N	% Open					
		0-3	4-5	6-10	11-15	16-25	26-50
Elizabethtown	286	49.7	13.6	18.2	9.4	6.3	2.8
Jonesboro	125	62.4	7.2	11.2	12.0	4.8	2.4
Murphysboro	200	29.5	24.0	29.0	10.0	4.5	2.5
Vienna	526	32.7	28.0	26.1	7.2	5.9	0.2
TOTAL	1137	39.7	21.4	23.0	8.8	5.7	1.5

Appendix C11. Percent frequency of openings by amount of cropland habitat within a 0.5-km radius for districts of the Shawnee National Forest.

District	N	% Cropland				
		0-3	4-10	11-25	26-40	>41
Elizabethtown	286	93.4	3.5	2.5	0.4	0.4
Jonesboro	125	93.6	3.2	3.2	0.0	0.0
Murphysboro	200	85.5	8.5	5.5	0.5	0.0
Vienna	526	90.3	5.5	3.8	0.4	0.0
TOTAL	1137	90.6	5.3	3.7	0.4	0.1

Appendix C12. Percent frequency of openings by amount of pasture/hayfield habitat within a 0.5-km radius for districts of the Shawnee National Forest.

District	N	% Pasture/hayfield					
		0-3	4-10	11-20	21-30	31-45	46-60
Elizabethtown	286	70.3	15.4	8.7	3.2	2.5	0.0
Jonesboro	125	84.0	8.8	5.6	1.6	0.0	0.0
Murphysboro	200	69.5	11.5	11.0	5.5	1.0	1.5
Vienna	526	77.2	11.4	8.2	2.3	1.0	0.0
TOTAL	1137	74.8	12.1	8.5	3.0	1.2	0.3

Appendix C13. Percent frequency of openings by distance to cropland for districts of the Shawnee National Forest.

District	N	Distance (m) to cropland							
		0-50	51-100	101-200	201-300	301-400	401-600	601-800	>801
Elizabethtown	289	0.7	0.7	2.8	2.4	3.8	6.2	11.1	72.3
Jonesboro	150	0.7	0.7	1.3	2.7	4.7	19.3	18.7	52.0
Murphysboro	364	3.6	1.7	1.9	7.4	5.5	17.6	18.4	44.0
Vienna	491	2.9	1.2	2.9	5.7	6.9	11.4	16.9	52.1
		—	—	—	—	—	—	—	—
TOTAL	1294	2.3	1.2	2.4	5.1	5.6	12.9	16.2	54.3

Appendix C14. Percent frequency of openings by distance to pasture/hayfield for districts of the Shawnee National Forest.

District	N	Distance (m) to pasture/hayfield							
		0-50	51-100	101-200	201-300	301-400	401-600	601-800	>801
Elizabethtown	303	6.6	4.6	8.3	11.9	5.9	18.2	10.6	34.0
Jonesboro	149	0.7	0.0	6.7	8.1	8.1	17.5	14.8	44.3
Murphysboro	365	6.3	3.3	12.1	11.0	10.1	19.7	13.4	24.1
Vienna	534	5.4	1.7	7.7	8.1	7.7	16.9	14.4	38.2
TOTAL	1351	5.4	2.6	8.9	9.7	8.0	18.0	13.3	34.1

Appendix C15. Percent frequency of openings by distance to open habitat for districts of the Shawnee National Forest.

Districts	N	Distance (m) to open habitat						
		0-100	101-200	201-300	301-400	401-600	601-800	>801
Elizabethtown	295	39.3	26.4	19.3	9.5	4.1	1.4	0.0
Jonesboro	149	47.7	26.2	10.7	10.1	4.7	0.0	0.7
Murphysboro	385	64.2	22.6	7.0	4.7	1.3	0.3	0.0
Vienna	534	52.4	23.2	15.7	5.2	2.6	0.6	0.2
TOTAL	1363	52.4	24.1	13.5	6.5	2.8	0.6	0.2

Appendix C16. Percent frequency of openings by distance to water source for districts of the Shawnee National Forest.

District	N	Distance (m) to water				
		0-50	51-100	101-200	201-300	301-400 >401
Elizabethtown	279	31.2	15.4	28.3	15.1	4.7 5.4
Jonesboro	196	56.6	18.4	15.8	4.6	4.1 0.5
Murphysboro	384	34.9	13.5	25.3	14.1	5.7 6.5
Vienna	534	26.8	15.9	28.5	16.7	7.1 5.1
TOTAL	1393	34.1	15.5	25.8	13.9	5.8 4.9

Appendix C17. Percent frequency of openings by distance to occupied dwelling for districts of the Shawnee National Forest.

District	N	Distance (m) to dwelling			
		0-200	201-500	501-900	>901
Elizabethtown	285	3.5	14.4	34.0	48.1
Jonesboro	143	0.7	5.6	33.6	60.1
Murphysboro	369	3.3	14.1	39.8	42.8
Vienna	526	0.8	10.3	24.0	65.0
TOTAL	1323	2.0	11.7	31.6	54.7

Appendix C18. Percent frequency of openings by number of occupied dwellings within a 0.5-km radius for districts of the Shawnee National Forest.

District	N	Number of dwellings				
		0	1	2-4	≥ 5	
Elizabethtown	299	85.0	10.4	4.7	0.0	
Jonesboro	150	96.7	1.3	1.3	0.7	
Murphysboro	387	85.8	10.6	2.6	1.0	
Vienna	534	93.8	5.1	1.1	0.0	
TOTAL	1370	89.9	7.4	2.3	0.4	

Appendix C19. Percent frequency of openings by distance to public gravel road for districts of the Shawnee National Forest.

District	N	Distance (m) to road				
		0-100	101-400	401-800	801-1200	1201-1600 >1601
Elizabethtown	240	16.7	15.4	12.1	14.2	5.4 36.3
Jonesboro	60	33.3	10.0	10.0	13.3	8.3 25.0
Murphysboro	213	10.3	20.2	16.9	13.2	7.5 31.9
Vienna	416	11.8	11.8	13.2	22.1	11.5 29.6
TOTAL	929	14.1	14.5	13.6	17.4	8.8 31.5

Appendix C20. Percent frequency of openings by kilometers of gravel or paved road within a 0.5-km radius for districts of the Shawnee National Forest.

District	N	Kilometers of road				
		0.0	0.1-0.5	0.6-1.0	1.1-1.5	1.6-2.0
Elizabethtown	294	65.7	5.4	17.0	9.5	2.4
Jonesboro	143	75.5	4.9	9.8	6.3	2.8
Murphysboro	373	61.1	8.9	17.4	8.0	3.2
Vienna	534	76.2	6.6	13.7	3.2	0.4
TOTAL	1344	69.6	6.8	15.0	6.3	1.9
						0.5

Appendix C21. Percent frequency of openings by number of managed openings within a 0.5-km radius for districts of the Shawnee National Forest.

District	N	Number of managed openings			
		0-1	2-4	5-7	>8
Elizabethtown	309	35.3	56.0	8.7	0.0
Jonesboro	152	48.7	47.4	4.0	0.0
Murphysboro	388	32.7	44.9	18.0	4.4
Vienna	534	30.5	53.6	14.0	1.9
TOTAL	1383	34.2	51.0	12.9	2.0

Appendix C22. Percent frequency of openings by number of managed openings within a 1.0-km radius for districts of the Shawnee National Forest.

Districts	N	Number of managed			
		0-4	5-10	11-15	≥16
Elizabethtown	308	32.1	54.6	12.3	1.0
Jonesboro	145	60.0	39.3	0.7	0.0
Murphysboro	388	29.9	51.8	12.4	5.9
Vienna	533	27.8	51.2	15.0	6.0
TOTAL	1374	32.8	50.9	12.2	4.2

Appendix C23. Percent frequency of openings by distance to managed opening for districts of the Shawnee National Forest.

Districts	N	Distance (m) to managed opening					
		0-100	101-200	201-300	301-400	401-600	601-800 >801
Elizabethtown	295	17.0	25.8	24.1	14.6	10.2	4.8 3.7
Jonesboro	149	18.1	26.2	22.2	15.4	9.4	3.4 5.4
Murphysboro	383	37.3	27.2	14.9	8.4	6.3	2.9 3.1
Vienna	534	39.0	24.7	20.4	7.1	6.7	1.5 0.6
TOTAL	1361	31.5	25.8	19.8	10.0	7.6	2.8 2.5

Appendix D. Definitions of new and revised original vegetation types for openings of the Shawnee National Forest.

Little bluestem

Little bluestem occurs over 50% of the area. Forbs vary, but common ones include perennial lespedezas and other native legumes. This type is representative of glades, oldfields, and remnant "barren" areas (especially in the Cretaceous Hills).

Forb, little bluestem

Little bluestem occurs over 10-30 % of the area. Goldenrod, panic grass and lespedeza are codominant to dominant. Mountain mint is also common. This type is characteristic of former pure stands of little bluestem that have been disturbed within the last five years.

Indian grass, big bluestem, little bluestem

Tall grass prairie community (warm season grass opening). Indian grass is usually dominant, but big bluestem can assume dominance. This type includes artificially established as well as natural sites (such as mesic sites within the Cretaceous Hills, and areas within the Southern Till Plain).

Fescue

Fescue occurs over 50% of the area. Sweet clover, and goldenrod are also common.

Deer's tongue, sedge, jewelweed

Deer's tongue covers over 50% of the area. Other common species include sedges, jewelweed, giant cane, false nettle, sea oats, rushes, and yellow crownbeard. This type is characteristic of openings occupying alluvial soils adjacent to small streams.

Panic grass, western ragweed, beggar-ticks, fleabane, goldenrod red top

Late annual and early perennial stage of secondary succession. Panic grasses are usually dominant, but western ragweed, fleabane, or red top can be important in some situations (dominance often varies depending on the available seed bank). Fleabane and aster are often seasonally highly visible, and goldenrod increases as succession progresses. Woody cover occurs over less than 20% of the area. This type is characteristic of disturbed openings 2-3 years past soil disturbance, without a tame legume component being planted.

Appendix D. Continued.

Beggar-ticks

Beggar-ticks covers over 50% of the area. Representative of recently disturbed sites in moist situations.

Tame legume

More than 50% of the area occupied by one or a combination of red, white or ladino clover and/or Korean lespedeza.

Tame legume, goldenrod, wild carrot, annual brome grasses

Red, white or ladino clover occurs over 15-3% of the area. Other important forbs include sweet clover and aster. Woody cover occurs over up to 30% of the area. This combination of goldenrod, wild carrot, and annual brome grasses with tame legumes often represents openings several years since being seeded to legumes.

Fescue, goldenrod

Fescue and goldenrod are codominants. Each could make up from 15-40% of the area. Other grasses such as red top, bluegrass, annual brome, and panic grass could be common. Forbs, which are common, include asters, native legumes, wild carrot, and cinquefoil. Woody cover could range up to 40%.

Orchard grass, forb

Orchard grass occurs over 50% of the area, but various forbs, such as goldenrod, and native legumes occur. Often a component of tame legumes is associated with this type.

Ragweed, wild carrot, lespedeza

Early secondary succession with annuals dominating. Ragweed is dominant until two years post disturbance. This type is characteristic of the early period of disced and seeded openings.

Goldenrod

Perennial forb stage. Goldenrod is dominant; however, panic grass, woodland sunflower, and annual brome grasses may be important. Aster,

Appendix D. Continued.

Goldenrod cont.

sweet clover, and native legumes are also common. Woody invasion of sassafras, sumac, persimmon, or blackberry often occurs with cover ranging from 0 to 45%.

Sassafras, persimmon, sumac

Woody invasion occupies more than 50% of the area. Herbaceous vegetation is persistent, with goldenrod, woodland sunflower, annual brome grasses, wild rye, and cinquefoil being common. This type is associated with openings four to five years post treatment.

Honeysuckle

Honeysuckle covers over 50% of the area. Remaining herbaceous vegetation varies.

Vetch

Vetch covers over 75% of the area. This type is introduced, and will form a lush mat of choking vegetation.

Serecia lespedeza

Serecia lespedeza occurs over 30 to 70% of the area. Usually forming a thick herbaceous cover.

Smooth brome

Smooth brome occurs over 30 to 70% of the area. Bluegrass is also common. Often representative of openings in old pasture areas.

Aster, sedge, beggar-ticks, moneywort, sawtooth sunflower

Asters and sedges are usually dominant, with varying amounts of other forbs depending on moistness of site. Rushes are also common. This type is characteristic of openings found along the floodplain of the Big Muddy River.

Appendix D. Continued.

Sweet clover

Sweet clover occurs over 50% of the area. May be associated with a wide variety of grasses and forbs.

Appendix E. Plants identified from classification of opening vegetation types and those comprising dominant surrounding forest types.

Scientific name ¹	Common name
<u>Acalypha</u> spp.	three-seeded mercury
<u>Acer</u> spp.	maple
<u>Achillea millefolium</u>	common yarrow
<u>Agrimonia</u> spp.	agrimony
<u>Agrostis alba</u>	red top
<u>Agrostis</u> spp.	tickle grass
<u>Allium vineale</u>	field garlic
<u>Ambrosia artemisiifolia</u>	common ragweed
<u>Ambrosia bidentata</u>	western ragweed
<u>Ambrosia trifida</u>	giant ragweed
<u>Andropogon gerardii</u>	big bluestem
<u>Andropogon virginicus</u>	broom sedge
<u>Anemone</u> spp.	anemone
<u>Apios americana</u>	groundnut
<u>Apocynum cannabinum</u>	dogbane
<u>Aralia spinosa</u>	devil's walking-stick
<u>Aristida</u> spp.	three awn
<u>Arundinaria gigantea</u>	giant cane
<u>Asclepias</u> spp.	milkweed
<u>Asclepias tuberosa</u>	butterfly-weed
<u>Ascyrum</u> spp.	St. Andrew's cross
<u>Asplenium platyneuron</u>	ebony spleenwort
<u>Aster</u> spp.	aster
<u>Betula nigra</u>	river birch
<u>Bidens</u> spp. ²	beggar-ticks
<u>Blephilia ciliata</u>	pagoda plant
<u>Boehmeria cylindrica</u>	false nettle
<u>Boltonia asteroides</u>	false aster
<u>Bromus</u> spp. ³	brome grass

Appendix E. Continued.

Scientific name	Common name
<u>Bromus inermis</u>	smooth brome
<u>Cacalia muhlenbergii</u>	great Indian-plantain
<u>Campanula americana</u>	American bellflower
<u>Campsis radicans</u>	trumpet creeper
<u>Carex</u> spp.	sedge
<u>Carya</u> spp.	hickory
<u>Cassia fasciculata</u>	partridge pea
<u>Ceanothus americanus</u>	New Jersey tea
<u>Cerastium</u> spp.	mouse-ear chickweed
<u>Cercis canadensis</u>	redbud
<u>Chamaesyce maculata</u>	nodding spurge
<u>Chasmanthium latifolium</u>	sea oats
<u>Chrysanthemum leucanthemum</u>	ox-eye daisy
<u>Cirsium</u> spp.	thistle
<u>Convolvulus arvensis</u>	field bindweed
<u>Cornus</u> spp.	dogwood
<u>Crataegus</u> spp.	hawthorn
<u>Crotalaria sagittalis</u>	rattlebox
<u>Croton</u> spp.	croton
<u>Crotonopsis elliptica</u>	rushfoil
<u>Cuscuta gronovii</u>	dodder
<u>Dactylis glomerata</u>	orchard grass
<u>Danthonia spicata</u>	poverty oat grass
<u>Daucus carota</u>	wild carrot
<u>Desmodium</u> spp.	tick trefoil
<u>Dianthus armeria</u>	deptford pink
<u>Digitaria</u> spp.	crab grass
<u>Diodia teres</u>	rough buttonweed
<u>Diospyros virginiana</u>	persimmon
<u>Elaeagnus umbellata</u>	autumn olive

Appendix E. Continued.

Scientific Name	Common name
<u>Elephantopus carolinianus</u>	elephant's-foot
<u>Elymus</u> spp.	wild rye
<u>Elymus hystrix</u>	bottlebrush grass
<u>Erigeron</u> spp. ⁴	fleabane
<u>Eupatorium</u> spp. ⁵	thoroughwort
<u>Euphorbia</u> spp. ⁶	spurge
<u>Festuca</u> spp.	fescue
<u>Fragaria virginiana</u>	wild strawberry
<u>Fraxinus</u> spp.	ash
<u>Galium</u> spp.	bedstraw
<u>Gerardia</u> spp.	foxglove
<u>Geum canadense</u>	white avens
<u>Gnaphalium</u> spp.	cudweed
<u>Graminae</u>	unidentified grass
<u>Helenium</u> spp.	sneezeweed
<u>Helianthus</u> spp.	sunflower
<u>Helianthus annuus</u>	common sunflower
<u>Helianthus divaricatus</u>	woodland sunflower
<u>Helianthus grosseserratus</u>	sawtooth sunflower
<u>Hemerocallis fulva</u>	orange day lily
<u>Hieracium</u> spp.	hawkweed
<u>Hordeum</u> spp.	barley
<u>Hydrangea arborescens</u>	wild hydrangea
<u>Hypericum punctatum</u>	spotted St. Johns-wort
<u>Impatiens</u> spp.	Jewel-weed
<u>Ipomoea</u> spp.	morning-glory
<u>Juglans nigra</u> ⁷	black walnut
<u>Juncus</u> spp.	rush
<u>Juniperus virginiana</u> ⁷	red cedar
<u>Krigia dandelion</u>	potato dandelion
<u>Labiatae</u>	mint family

Appendix E. Continued.

Scientific name	Common name
<u>Lactuca canadensis</u>	wild lettuce
<u>Lespedeza</u> spp.	lespedeza
<u>Lespedeza bicolor</u>	bicolor lespedeza
<u>Lespedeza stipulacea</u>	Korean lespedeza
<u>Lespedeza striata</u>	Japanese lespedeza
<u>Lespedeza hirta</u>	hairy bush clover
<u>Lespedeza cuneata</u>	sericea lespedeza
<u>Litris spicata</u>	marsh blazing-star
<u>Liquidambar styraciflua</u> ⁷	sweet gum
<u>Liriodendron tulipifera</u> ⁷	tulip tree
<u>Lobelia inflata</u>	Indian tobacco
<u>Lobelia puberula</u>	downy lobelia
<u>Lobelia siphilitica</u>	blue cardinal-flower
<u>Lolium multiflorum</u>	Italian rye grass
<u>Lonicera</u> spp.	honeysuckle
<u>Ludwigia</u> spp.	false loosestrife
<u>Lycopus rubellus</u>	stalked water horehound
<u>Lysimachia ciliata</u>	fringed loosestrife
<u>Lysimachia nummularia</u>	moneywort
<u>Melilotus</u> spp.	sweet clover
<u>Monarda</u> spp.	wild bergamot
<u>Muhlenbergia</u> spp.	muhly grass
<u>Oenothera</u> spp.	evening primrose
<u>Onoclea sensibilis</u>	sensitive fern
<u>Oxalis</u> spp.	wood sorrel
<u>Panicum</u> spp.	panic grass
<u>Panicum clandestinum</u>	deer's tongue
<u>Panicum miliaceum</u>	proso millet
<u>Parthenocissus quinquefolia</u>	Virginia creeper
<u>Paspalum</u> spp.	bead grass
<u>Passiflora</u> spp.	passion-flower

Appendix E. Continued.

Scientific name	Common name
<u>Perilla frutescens</u>	beefsteak plant
<u>Phleum pratense</u>	timothy
<u>Physalis</u> spp.	ground cherry.
<u>Phytolacca americana</u>	pokeweed
<u>Pilea pumila</u>	clearweed
<u>Pinus strobus</u>	white pine
<u>Plantago</u> spp.	plantain
<u>Platanus occidentalis</u>	sycamore
<u>Poa compressa</u>	canadian bluegrass
<u>Poa pratensis</u>	Kentucky bluegrass
<u>Polygala sanguinea</u>	field milkwort
<u>Polygonum</u> spp.	smartweed/knotweed
<u>Potentilla simplex</u>	common cinquefoil
<u>Prunella vulgaris</u>	self-heal
<u>Prunus</u> spp.	cherry
<u>Pycnanthemum</u> spp.	mountain mint
<u>Quercus</u> spp.	oak
<u>Quercus lyrata</u> ⁷	overcup oak
<u>Quercus marilandica</u> ⁷	blackjack oak
<u>Quercus pagodaefolia</u> ⁷	cherry-bark oak
<u>Quercus palustris</u> ⁷	pin oak
<u>Quercus shumardii</u> ⁷	Shumard's oak
<u>Quercus stellata</u> ⁷	post oak
<u>Rhus copallina</u>	winged sumac
<u>Rhus glabra</u>	smooth sumac
<u>Robinia pseudoacacia</u>	black locust
<u>Rosa</u> spp.	rose
<u>Rubus</u> spp.	blackberry
<u>Rudbeckia</u> spp.	coneflower
<u>Rumex acetosella</u>	sour dock
<u>Sabatia angularis</u>	marsh pink

Appendix E. Continued.

Scientific name	Common name
<u>Sassafras albidum</u>	sassafras
<u>Schizachyrium scoparium</u>	little bluestem
<u>Scutellaria</u> spp.	skullcap
<u>Secale cereale</u>	rye
<u>Setaria</u> spp.	foxtail grass
<u>Silphium integrifolium</u>	rosinweed
<u>Silphium terebithinaceum</u>	prairie-dock
<u>Smilax</u> spp.	Catbrier
<u>Solanum carolinense</u>	horse-hettle
<u>Solidago</u> spp. ⁸	goldenrod
<u>Solidago graminifolia</u>	grass-leaved goldenrod
<u>Sorghastrum nutans</u>	Indian grass
<u>Sorghum vulgare</u>	milho
<u>Sorghum halepense</u>	Johnson grass
<u>Specularia biflora</u>	Venus' looking-glass
<u>Spermacoce glabra</u>	smooth buttonweed
<u>Stachys</u> spp.	hedge nettle
<u>Strophostyles</u> spp.	wild bean
<u>Stylosanthes biflora</u>	pencil-flower
<u>Symphoricarpos orbiculatus</u>	coral berry
<u>Teucrium</u> spp.	germander
<u>Torilis japonica</u>	hedge parsley
<u>Toxicodendron radicans</u>	poison ivy
<u>Tridens flavus</u>	purple-top
<u>Trifolium campestre</u>	low hop clover
<u>Trifolium pratense</u>	red clover
<u>Trifolium repens</u>	white dutch clover
<u>Trifolium repens</u> f. <u>ludigense</u>	ladino clover
<u>Triticum aestivum</u>	winter wheat
<u>Ulmus alata</u>	winged elm
<u>Ulmus rubra</u>	slippery elm

Appendix E. Continued.

Scientific name	common name
<u>Verbascum thapsus</u>	woolly mullein
<u>Verbena</u> spp.	vervain
<u>Verbesina helianthoides</u>	yellow crownbeard
<u>Vernonia</u> spp.	ironweed
<u>Vicia</u> spp.	vetch
<u>Vigna sinensis</u>	cow pea
<u>Viola</u> spp.	violet
<u>Vitis</u> spp.	grape
<u>Vulpia octoflora</u>	six-weeks fescue

¹Nomenclature of plants conforms to Schery (1972) and Mohlenbrock (1975).

²primarily Bidens aristosa

³annual brome grasses

⁴primarily Erigeron annuus and E. strigosus

⁵primarily Eupatorium rugosum

⁶primarily Euphorbia corollata

⁷dominant surrounding tree species found in text

⁸primarily Solidago canadensis and S. nemoralis

Job 2. Computerize Data From SNF Wildlife Openings.

The following User's Manual and accompanying set of diskettes comprises the final product from Job 2.

A DATA STORAGE AND RETRIEVAL SYSTEM FOR
WILDLIFE OPENINGS IN THE SHAWNEE NATIONAL FOREST

User's Manual

September 1, 1986

Cooperative Wildlife Research Laboratory
Southern Illinois University-Carbondale

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FORWARD

This manual describes a computer system for the storage and retrieval of information about individual wildlife openings in the Shawnee National Forest. The software package, DB MasterTM (Stoneware, Inc., San Rafael, CA), runs on an Apple II personal computer. The storage and retrieval system and the information contained therein were developed and compiled by the Cooperative Wildlife Research Laboratory, Southern Illinois University-Carbondale as part of Federal Aid Project W-94-R, Illinois Department of Conservation. Information is stored separately by Ranger District on 5 1/4" "floppy" diskettes. Descriptions are incomplete for some openings; however, at least partial information is contained for all openings known to exist as of July 1985. The system is designed as a working tool and accommodates the addition, deletion, and editing of information on a continuing basis.

INTRODUCTION

Hardware Requirements

The system requires an Apple II, II Plus, or IIe computer with at least 48K of RAM memory. It is designed to use Apple's DOS 3.3 16-sector disk operating system with a minimum of one disk drive, although two disk drives are recommended for most efficient use. The drives should be connected to Slot #6. A printer is also recommended although the system can be used without one. The system will operate with either parallel or serial interface cards but is not compatible with an 80-column screen format.

Characteristics of DB Master

DB Master is a data base management system that allows for the creation, storage, editing, updating, retrieval, and reporting of organized information. This manual addresses only those features of the system relevant to the present application (see DB Master Manual for complete description of capabilities). Certain key words and phrases used throughout are defined as follows: Inventory data are organized into individual "RECORDS", one for each forest opening. Each record consists of 23 "FIELDS" or units of information. A blank record containing no information is a "FORM"; each record or form occupies a single "PAGE" or video screen image. The entire collection of records representing all openings in a district is called a "FILE".

A minimum of three floppy diskettes are required for each file: (1) the DB Master PROGRAM disk, (2) a UTILITY disk containing information about the file, and (3) a DATA or MASTER disk containing the actual inventory data. A fourth disk (SORT) is also needed to temporarily store sorted files before they are printed.

DB Master is generally "user-friendly". Instructions on the screen tell the user when and where to insert appropriate disks during the session. Prompting messages listing available options and other information also appear frequently on the screen.

Inventory Data

Each record or form accommodates the following information about individual forest openings: district, compartment, opening number, date of data entry, size, slope, access, distance to water, type of water, peripheral edge, most recent management, ecological land type, opening vegetation, surrounding forest animal habitat type, surrounding forest community type, surrounding land use, number of nearby openings, aerial photo reference number, and general comments. Each field is assigned a particular length (number of characters allowed) and type (alpha, numeric, etc). A complete list of variables along with the length and type of value permitted for each is given in Appendix A and can also be accessed from the computer (see File Maintenance). Code descriptions for each variable are listed in Appendix B and are also maintained in computer memory.

GETTING STARTED

This manual assumes that the user has a general knowledge of personal computers including the loading and unloading of diskettes, their care and maintenance, the concept of "booting", and keyboard use. Like many computer programs, DB Master sometimes requires the entry of a letter from the keyboard ("N" for example) while simultaneously depressing the CONTROL key. Hereafter, this will be indicated by CNTR/N or whatever letter might be called for. The entry of a specific letter, symbol, or number will usually be indicated by enclosing the desired entry in quotation marks. DO NOT TYPE IN THE QUOTATION MARKS. For example, the command ENTER "(" means enter a left parenthesis only. NOTE: all keyboard entries must be made with the CAPS LOCK down.

To begin a session, "boot" DB Master by inserting the PROGRAM disk in Drive #1 and turning on the power, or entering "PR#6" if power is already on. After the title page has been displayed, you will be asked to indicate the number of disk drives connected. Enter the appropriate number and press the RETURN key. You will then be instructed to insert the UTILITY disk in Drive #2 and press the RETURN key (note that in a 2 drive configuration, the PROGRAM and UTILITY disks can be loaded simultaneously prior to booting). Next, you will be asked to enter the correct date (if you reboot DB Master without turning off the power, the previous two questions will not be reasked). The Main Menu should now be displayed on the screen. All subsequent DB Master facilities and options are accessed through the Main Menu. To return to the Main Menu from any mode except Reporting enter CNTR/C.

Aside from physically damaging a disk, there is little chance of destroying the program or data files during a session. A few rules must be followed however:

1. NEVER attempt to remove a diskette while the disk drive is "whirring" or while the light is red.
2. NEVER enter anything from the keyboard while the disk drive is in operation or while the program is printing to the screen or printer. Wait for the flashing cursor to indicate that the program is ready for further input.
3. NEVER exit DB Master except by entering "8" (Close Files and Exit) from the Main Menu.

ADDING RECORDS

The basic data file can be updated by adding additional records, although the original record format must be maintained. Each DATA disk can hold approximately 2,500 records, but if necessary, data from one file can be stored on more than one DATA disk. Use the following procedure to add records to a file:

1. Enter "2" from the Main Menu.
2. Enter "Y" or "N" to question about printing new records.
3. Replace PROGRAM disk in Drive #1 with DATA disk.
4. The last record entered (and date of entry) will appear on screen.
5. Press RETURN key and a blank form will appear on screen.
6. Enter data in fields
 - a) to accept default value for district, press RETURN key
 - b) to skip over a field, press RETURN key
 - c) to back up to a previous field, press ESC key, then reenter data or press CNTR/V to void entry
 - d) computer will sound a warning if you attempt to enter a value of incorrect length or type
7. Press ESC key to edit new record before saving or CNTR/A to add (save) record to file.
8. Another blank form will appear on screen; you can now create another new record as described above, or press CNTR/C to return to Main Menu. (If you return to Main Menu before pressing CNTR/A, the new record will not be saved.)

FINDING AND DISPLAYING RECORDS

DB Master permits you to find and display any record in a file. Various types of search criteria can be established to locate a particular record or group of records. Individual records are stored in order first by compartment number then by opening number. These two fields, along with the district designation, are called PRIMARY KEYS. Searches involving primary keys are relatively fast; those using other fields are somewhat slower. To find and display a record, use the following procedure:

1. Enter "1" from the Main Menu.
2. Replace PROGRAM disk in Drive #1 with DATA disk.
3. A blank form will appear on screen.
4. To scan or search records in primary key order, press CNTR/F to display the first record, then CNTR/N to display each succeeding record.
5. To find a particular record, enter search criteria on blank form (see below) and press CNTR/F. The first record matching the criteria will be displayed. To find each succeeding record that also matches the criteria, press CNTR/N.
6. To begin a new search, press CNTR/F; to return to Main Menu press CNTR/C.

Types of Searches

1. EXACT search. This search returns the record(s) that exactly matches the established criteria.
 - a) move cursor to desired field and enter value to be found
2. RANGE (RNG) search. This search returns the record(s) within a range of values for a particular field.
 - a) move cursor to field and enter " " (Shift/6)

- b) program will prompt you to enter minimum value for range
 - c) duplicate field will appear at bottom of screen and program will prompt entry of maximum value for field
3. INCLUDES (INCL) search. This search returns the record(s) containing a specified character string located anywhere within an alphanumeric field.
- a) move cursor to desired field and enter "()"
 - b) enter character string to be found
4. RELATIONAL searches. These searches return the record(s) which have the following relationships to the indicated value: less than (<), equals (=), greater than (>), not equal to (<>), greater than or equal to (>=), and less than or equal to (<=).
- a) move cursor to desired field
 - b) enter relational sign and value
5. AND search. When criteria are entered for more than one field, this search returns only the record(s) that matches all of the established criteria
- a) move cursor to first field and enter search criteria
 - b) move cursor to second field and enter search criteria (up to 20 separate criteria can be entered at one time)
6. OR search. When criteria are entered for more than one field, or multiple criteria are entered for a single field, this search returns the record(s) that matches any of the established criteria.
- a) move cursor to first field and enter criteria
 - b) press CNTR/O and a blank form will appear on screen
 - c) enter the additional criteria (up to 10 may be entered)
 - d) if multiple criteria appear on a single page, they will be treated as an "AND" search

EDITING RECORDS

Information in individual fields of any record can be added, deleted, or changed; however, the field's original length and type must be maintained.

Use the following procedure:

1. Display the record to be edited.
2. Press ESC key to enter edit mode.
3. Add, delete, or change data in any or all fields.
 - a) move cursor forward by pressing RETURN key or backward by pressing ESC key
 - b) delete value at cursor by pressing DELETE key, add or change value by typing over
4. Press CNTR/V to void edit or CNTR/S to save edit.
5. Press ESC key to edit same record, or CNTR/F to search for new record, or CNTR/C to return to Main Menu.

DELETING RECORDS

Previously created records can be permanently deleted from the file by using the following procedure:

1. Display record to be deleted.
2. Press ESC key to enter edit mode.
3. Press CNTR/D to delete entire record.
4. Verify deletion by answering "YES".
5. Press CNTR/F to prepare for another search and display, or CNTR/C to return to Main Menu.

PRINTING RECORDS

The system allows you to print any or all fields for any or all records using a variety of formats.

Printing Individual Records (fields listed vertically 1 per row)

1. Enter "1" from the Main Menu.
2. Replace PROGRAM disk in Drive #1 with DATA disk.
3. Display record to be printed.
4. Press CNTR/P.
5. If printer slot is #1, press RETURN.
6. Turn on printer and press RETURN.
7. Record will print.
8. Display next record to be printed or press CNTR/C to return to Main Menu.

Listing Records to Printer (fields listed vertically 1 per row)

1. Enter "3" from the Main Menu.
2. If printer slot is #1, press RETURN.
3. Turn on printer and press RETURN.
4. Replace PROGRAM disk in Drive #1 with DATA disk.
5. A blank form will appear on screen.
6. To print all records in file in primary key order, press CNTR/F.
7. To print selected records, enter search criteria on blank form(s) and press CNTR/F.

Printing Records in Report Form (user controlled format)

- A. Each report requires 4 formats: (1) a PAGE Format that determines overall appearance of the report, (2) a DATA Format that controls the data (fields) to be printed, (3) a SORT format that determines

the order in which records are printed, and (4) a SELECT format that determines which records are printed. New formats can be created for each report, or existing ones used, or any combination (see DB Master Manual for complete instructions). For present purposes, PAGE, DATA (3), and SORT Formats have already been created and stored.

1. Enter "5" from the Main Menu.
2. Create new report, enter "Y".
3. Enter "1" for page format selection, then enter "4" to move on to next format.
4. Data format selection will appear on screen; enter number for desired data format (see Appendix C), then enter "4" to move on to next format.
5. Sort format selection will appear on screen; enter "1", then enter "4" to move on to next format.
6. Record selection format will appear on screen.
7. To print all records in the file, enter "1", then enter "4" to move on to next format and proceed to instruction 14 on this page.
8. To print selected records, enter " ", then enter "2" to Replace.
9. A blank form will appear on screen.
10. Enter search criteria (see page 6) on blank form(s) and press CNTR/F when finished, then press CNTR/S.
11. Enter "SELECT" as name for search criteria.
12. Enter "N" to question about storing formats.
13. Enter report title if desired, otherwise press RETURN.
14. Enter "Y" if report is to be printed.
15. Press RETURN key if date is correct.
16. Replace PROGRAM disk in Drive #1 with DATA disk and press RETURN.

17. Check report setup, enter "0" if ok.
18. Turn on printer and follow screen instructions to begin and halt printing.
19. Follow instructions to return to Main Menu when finished.

FILE MAINTENANCE

The File Maintenance Module performs various tasks including copying and reblocking files and providing information about their contents. This module is accessed by entering "6" from the Main Menu. The system will then ask you to insert the PROGRAM disk in Drive #1; if it is already in place, simply press RETURN.

Reblocking Files (File Backup)

Reblocking files achieves two purposes: (1) it reorganizes existing information in the most efficient possible manner, and (2) it creates backup disks. NOTE: the DB Master PROGRAM disk cannot be copied; however, both the UTILITY and DATA disks should be periodically reblocked. This requires four diskettes (the original UTILITY and DATA disks and 2 blank diskettes). The reblocking operation requires considerable disk switching, and the prompting messages are not particularly clear. Therefore, it is recommended that the inexperienced user carefully follow the steps listed below until familiar with the procedure:

1. Make sure the original and new (soon-to-be-reblocked) UTILITY and DATA disks are clearly labeled.
2. Enter "1" from the File Maintenance Menu.
3. Replace the PROGRAM disk in Drive #1 with the new UTILITY disk and press RETURN.
4. Wait for reblocking to be completed.
5. Replace the newly reblocked UTILITY disk in Drive #1 with the original DATA disk and press RETURN.
6. Replace the original UTILITY disk in Drive #2 with the new DATA disk and press RETURN.
7. Wait for reblocking to be completed.

8. Replace the newly-reblocked DATA disk in Drive #2 with either the original or newly-reblocked UTILITY disk and press RETURN.
9. Replace the original DATA disk in Drive #1 with the PROGRAM disk and press RETURN.
10. Proceed as desired.

File Statistics

This option (#2 on the File Maintenance Menu) will indicate the number of records in your file. It will also list the name, type and length of each field. This information may be displayed on the screen or sent to the printer by following directions on the screen.

Field Codes

DB Master allows you to store short codes in numeric or alphanumeric fields while retaining full descriptions of these codes elsewhere for review or printing. To examine the codes and descriptions for a particular field, do the following:

1. Enter "4" from the File Maintenance Menu.
2. A list of fields and their numbers will appear on screen; select the desired field.
3. Another menu will appear; enter "1" to list code descriptions.
4. Enter starting code value or press RETURN.
5. Indicate whether you want information sent to printer.
6. A list of codes and descriptions now appears on screen or is printed.
7. Press RETURN if another page is needed to display all codes; otherwise press ESC.
8. Enter "3" to repeat process for a different field, or "5" to return to File Maintenance Menu.

Print Parameters

Communication between computer and printer is controlled by a series of print parameters. By altering the values of these parameters, DB Master can be made to work with a variety of printers. The current set of parameters are compatible with several types of Apple dot matrix printers. If you have a different type, you may have to change one or more of the parameters by entering "6" from the File Maintenance Menu. See DB Master Manual pages 108-111 for further details.

APPENDIX A
FIELD DESCRIPTIONS

Field Name	Description	Length and Type
1. Dist	Ranger district (code)	1 letter
2. Comp	Compartment number	3-digit number
3. No	Opening number	2-digit number
4. Date	Month and year of data entry	4-digit number
5. Size (A)	Size of opening (0.1a)	3-digit number w/decimal pt
6. Slope (%)	Percent prevailing slope	2-digit number
7. Access	Access to opening (code)	1-digit number
8. Water (m)	Distance to nearest water (m)	4-digit number
9. Type	Type of nearest water (code)	1-digit number
10. Edge (%)	% perimeter w/transitional veg	2-digit number
11. Mgmt	Most recent treatment	30-character string
12. Opening ELT	Ecological land type (code)	3 letters
13. Opening VEG	Characteristic vegetation (code)	2-digit number
14. Forest AHT	Animal habitat type (code)	2-digit number
15. Forest CMT	Community type (code)	3-digit number
16. LU(.5K):CRP	% cropland within .5K radius	2-digit number
17. PAS	% pasture within .5K radius	2-digit number
18. DEC	% deciduous forest within .5K	2-digit number
19. CON	% coniferous forest within .5K	2-digit number
20. OPN	% other land within .5K	2-digit number
21. # open	number managed openings within .5K	2-digit number
22. Photo	Aerial photo reference number	8-character string
23. Notes	Misc. comments	30-character string

APPENDIX B
CODE DESCRIPTIONS

Field	Code	Description
1. District	E	Elizabethtown Ranger District
	J	Jonesboro Ranger District
	M	Murphysboro Ranger District
	V	Vienna Ranger District
7. Access	1	Paved
	2	Gravel, general use
	3	Dirt/grass, general use
	4	4-wheel drive truck
	5	Tractor
	6	3-wheeler
	7	No vehicle access
9. Type of nearest water	0	Intermittent stream
	1	small stream, 1-3m wide
	2	stream, 3-10m wide
	3	river, >10m wide
	4	seep or spring
	5	intermittent water hole
	6	permanent water hole
	7	fish pond (stocked)
	8	marsh/swamp
	9	lake
12. Ecological land type	CPB	Coastal Plain Bottomlands
	CPC	Coastal Plain Cretaceous Hills
	GSH	Greater Shawnee Hills
	LSH	Lesser Shawnee Hills
	MRB	Mississippi River Bottomlands
	OHS	Ozark Hills
	STP	Southern Till Plain
	WBB	Wabash Border Bottomlands
13. Characteristic vegetation	42	Little bluestem
	45	Indian grass, big bluestem, little bluestem
	46	Orchard grass, forb
	47	Ragweed, wild carrot, lespedeza
	48	Broom sedge, panic grass, aster
	49	Purple top, bluegrass, panic grass, coralberry
	51	Goldenrod

APPENDIX B, continued

Field	Code	Description
	54	Sassafras, persimmon, sumac
	56	Fescue
	57	Cool season grasses
	58	Cereal grain
	59	Tame legumes
	60	Legume, goldenrod, wild carrot, annual brome grasses, sweetclover
	61	Fescue, goldenrod
	62	Deer's tongue, sedge, jewelweed - - -
	63	Forb, Little bluestem
	64	Panic grass, western ragweed, beggar-ticks, fleabane, goldenrod, red top
	65	Beggar-ticks
	66	Honeysuckle
	67	Vetch
	68	Sericea lespedeza
	69	Smooth brome
	70	Aster, sedge, beggar-ticks, moneywort, sawtooth sunflower
	71	Sweetclover
14. Animal habitat type	7	Grassland cool season - forbes
	8	Grassland warm season - forbes
	9	Annuals
	10	Cereal grains
	11	Legumes (tame) and forbes
	12	Open shrub - grass
	15	Perennials
	17	Young deciduous upland
	18	Young coniferous upland
	19	Young deciduous-coniferous upland
	20	Immature deciduous upland
	21	Immature coniferous upland
	22	Immature deciduous-coniferous upland
	23	Mature deciduous upland (open understory)
	24	Mature deciduous upland (dense understory)
	25	Mature deciduous lowland
	26	Old growth deciduous upland
	27	Mature coniferous upland
	28	Mature deciduous-coniferous upland
	29	Old growth deciduous upland
	30	Old growth coniferous upland
	31	Old growth deciduous-coniferous upland

APPENDIX B, continued

Field	Code	Description
	40	Other
	41	Young deciduous lowland
	42	Immature deciduous lowland
	43	Undifferentiated open
	46	Regeneration 0-3 years old
	47	Regeneration 4-9 years old
15. Forest Community type	31	White pine (0-9 yrs)
	32	White pine (10-69 yrs)
	34	White pine (70-119 yrs)
	35	White pine (120+ yrs)
	250	Upland opening (undifferentiated)
	251	Upland opening grass
	253	Upland opening shrub
	311	Southern pine (0-9 yrs)
	312	Southern pine (10-19 yrs)
	313	Southern pine (20-39 yrs)
	314	Southern pine (40-69 yrs)
	315	Southern pine (70+ yrs)
	351	Cedar (0-9 yrs)
	352	Cedar (10-59 yrs)
	354	Cedar (60-89 yrs)
	355	Cedar (90+ yrs)
	441	Oak pine (0-9 yrs)
	442	Oak pine (10-39 yrs)
	444	Oak pine (40-59 yrs)
	445	Oak pine (60+ yrs)
	511	Blackjack/post oak (0-9 yrs)
	512	Blackjack/post oak (10-19 yrs)
	513	Blackjack/post oak (20-39 yrs)
	514	Blackjack/post oak (40-99 yrs)
	515	Blackjack/post oak (100+ yrs)
	561	Cove hardwoods (0-9 yrs)
	562	Cove hardwoods (10-19 yrs)
	563	Cove hardwoods (20-79 yrs)
	564	Cove hardwoods (80-99 yrs)
	565	Cove hardwoods (100+ yrs)
	591	Oak-hickory (0-9 yrs)
	592	Oak-hickory (10-19 yrs)
	593	Oak-hickory (20-79 yrs)
	594	Oak-hickory (80-99 yrs)
	595	Oak-hickory (100+ yrs)
	611	Pin oak (0-9 yrs)
	612	Pin oak (10-19 yrs)
	613	Pin oak (20-39 yrs)
	614	Pin oak (40-69 yrs)
	615	Pin oak (70+ yrs)
	771	Bottomland hardwoods (0-9 yrs)
	772	Bottomland hardwoods (10-19 yrs)

APPENDIX B, continued

Field	Code	Description
	773	Bottomland hardwoods (20-39 yrs)
	774	Bottomland hardwoods (40-69 yrs)
	775	Bottomland hardwoods (70+ yrs)
	781	Walnut (0-9 yrs)
	782	Walnut (10-39 yrs)
	784	Walnut (40-69 yrs)
	785	Walnut (70+ yrs)
	881	Black locust (0-9 yrs)
	883	Black locust (10-39 yrs)
	884	Black locust (40+ yrs)

APPENDIX C

AVAILABLE DATA FORMAT SELECTIONS FOR REPORTING

Number	Name	Data Printed
1	All fields	All 23 fields, 3 lines per record
2	Opening ID ¹	Compartment and opening number
3	Detailed ²	Compartment and opening number, ecological landtype, community type, size, slope, access, distance to and type of water, surrounding land use, opening vegetation, and treatment

¹Format #3 in Vienna and Murphysboro file.

²Format #4 in Vienna and Murphysboro file.



